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TechnologyReview

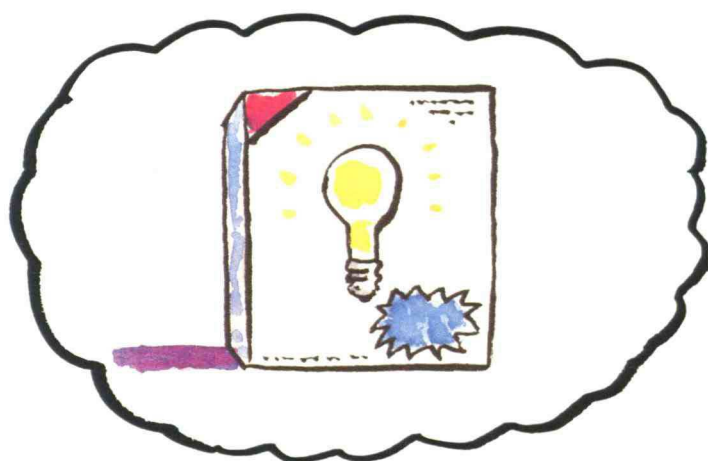
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APRIL 1986

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IDEAS TO PRODUCTS

**WHY JAPANESE ENGINEERS
GET THERE FASTER**



MURPHY

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technology review

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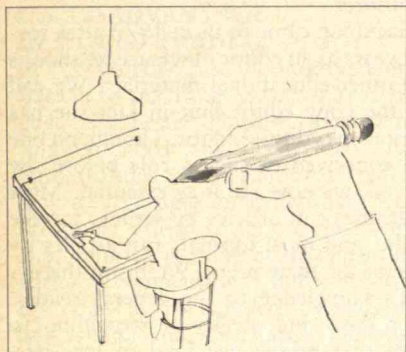
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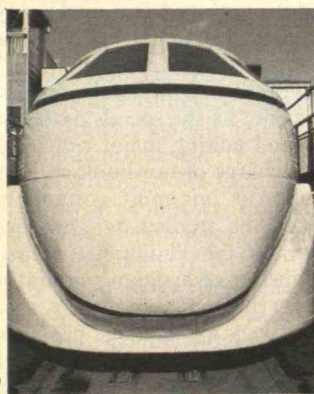
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A FIRE RARELY SEEN.

TechnologyReview



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Diversity

Articles in this issue weigh the controversies over exporting technology to the Third World, follow Harvard geneticist Matthew Meselson into the Laotian jungle to question the evidence of Soviet biological and chemical warfare, compare how Japanese and American companies manage engineers, and assess the feasibility of high-speed rail in the United States.

In this diversity we see a common thread. Our goal is to illuminate the many different roles of technology in modern life—the many ways it is tied to economic, political, and social affairs.

This diversity of content is reflected in the varied backgrounds that the editors bring to their tasks. Such an observation is timely as we introduce three changes in the *Review's* masthead: Marc Miller has joined the *Review* as senior editor. Sandra Hackman is undertaking increased responsibilities for soliciting and editing major articles. And Elizabeth Fullon is now devoting full time to design and production—helping to turn our writers' words into the handsome visual experience on which our readers so often comment.

Miller first studied chemical physics and then switched to history and literature for his baccalaureate at M.I.T. He went on for a doctorate in American history at Boston University while serving as assistant director of the M.I.T. Oral History Project. Before joining us Miller was for eight years research director of the Institute for Southern Studies in Durham, N.C., and managing editor of its magazine, *Southern*

Exposure.

Hackman came to us in 1979 after several years as an editor of science textbooks and other educational materials. We call her the copy editor, but in fact she has become the editors' editor. Though no one had conceived of such a role before she arrived, we now see it as essential. Most magazines run articles by writers for the public, and most journals run articles by experts for their peers. We bring the expert's knowledge to the general reader. After days and weeks of struggling to make that bridge, we tend to lose perspective. Hackman sets us straight and has steadily improved the readability of the magazine. Hackman has also had stewardship of "Books and Comment," choosing writers and the books on which they comment. As she spends more time soliciting and editing major articles, she will retain charge of our book reviews.

Fullon is our most cosmopolitan colleague. She studied and practiced journalism in the Philippines before taking administrative assignments first in Israel, then in Boston, and finally in 1981 at *Technology Review*. She has also written for the *Review*, worked with both patience and imagination to obtain appropriate illustrations for our articles, and helped us on matters of military technology with which she is familiar through her lively interest in international affairs.

—John Mattill

Left to right: Elizabeth Fullon, Sandra Hackman, and Marc Miller collaborate on an article.



Industrial Policy, Videotex, and Career Options

U.S. DISADVANTAGE IN WORLD TRADE

In "A World-Class Economy: Getting Back into the Ring" (*August/September*, page 27), Lester Thurow offers a fuzzy solution called "industrial policy" to the hard realities of international trade. He may well be right in saying that "we can no longer afford to ignore the fact that U.S. industry is being beaten up in international competition." But much of the rest of his article is flawed by inaccuracy, half-truths, and speculative conclusions that clearly will not stand that test of unbiased examination.

The United States does not, as Thurow claims, already have an industrial policy. What we have now and have had in the past is a series of misdirected ad hoc political responses to national and international economic problems.

Thurow is wrong to use specialty steel as an example of an industry that cannot compete. Indeed, the specialty-steel industry is not "competitively weaker" after protection, as he states, but instead remains the world leader. The U.S. International Trade Commission has determined that the industry is viable, and the Office of Technology Assessment and foreign competitors have agreed. The president has said that the U.S. specialty-steel industry is "technologically advanced, innovative, and export oriented."

My firm is a good example. We invest approximately 4 percent of our sales revenue in technology, we have remained consistently profitable, we are known throughout the world for our technological advances in process as well as product development, and we have earned a greater return on invested capital than any of our Japanese or other foreign competitors have.

Yet regardless of the efficiency and technological improvements we continue to make, we can be driven out of business by less efficient companies that have unlimited financial resources, and that benefit from their countries' strategy of capturing our markets by encouraging firms to sell below cost. Not once did Thurow mention this aspect of the international trade problem. When the market is distorted by subsidized and below-cost imports, only selective protectionism as part of a broader trade policy will work. We don't need the industrial policy Thurow proposes. What we need are effective trade laws, vigorously enforced.

Contrary to Thurow's statements, only one or two steel mini-mills are generating profits worthy of the investment. Since it is never clear which nation will next target us for steel exports, only a fool would invest in U.S. steel plants, regardless of their economic viability. We continue to invest because specialty steel is our only business. We believe that this nation will soon recognize the vital need for a trade policy that satisfies U.S. self-interest and permits efficient, technologically advanced firms to survive and prosper. If we are wrong, the manufacturing sector in the United States will disappear, and so will we.

R. P. SIMMONS
Pittsburgh, Pa.

R.P. Simmons is president and chief executive officer of Allegheny Ludlum Steel Corp.

RELIGION AND MORALITY

In his reply to Gary Johnson's comments on "Does an Embryo Have Rights?" author Peter Singer rejects religion as a source of moral standards (*Letters, October*, page 4). Does Singer mean that only atheists have the right to discuss morality? In taking such a stance, he appears to be guilty of the very arrogance that he professes to abhor.

PAUL S. MASSER
Fair Oaks, Calif.

THE MARKET FOR VIDEOTEX

In "The Inevitable March of Videotex" (*October*, page 22), Ralph Lowenstein and Helen Aller seem to promise a little too much a little too soon. Just because a technology works well and offers genuine benefits doesn't mean it will be widely and quickly adopted. Videotex requires the user constantly to decide what to look at next—a choice most people would rather not be bothered with. They prefer a broadcast, in which the choice is already made, or a newspaper, in which the choice suggests itself to the wandering eye. And in fact when people do use videotex, they use it less for information retrieval than for chatting with other users.

Another fact the authors overlook is that media habits change slowly, especially when the medium in question demands intellectual involvement. For example, newspaper audiences are much more stable than radio audiences, who usually listen passively while doing something else, such as driving or working. Vid-

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ADVANCED CERAMICS IN JAPAN

IT IS A FACT THAT there has been a definite lack of important information on Japan's "ADVANCED" Ceramics Industry in this country. And how difficult this information has been to acquire.

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eotex demands even more intellectual involvement than print, so its slow growth should come as no surprise.

Interest in videotex does correlate strongly with interest in computers. Thus the immediate market for videotex probably does not extend much beyond the population of computer owners, which, in the United States, is now approaching 15 percent of the general population. Coupling videotex with personal computers means opportunities, however. We're beginning to see systems that integrate personal computers' graphics with videotex-supplied data, that update their databases with fresh information, and that integrate banking with record keeping, brokerage with portfolio management.

In any event, videotex is no threat to newspapers. One of the main reasons people read the local paper is to reinforce a feeling of community: we like to know that we're getting the same information as our neighbors. Videotex won't be able to compete until far more than one or two people in a neighborhood are using it. In short, the social and economic impact of this technology is likely to be more gradual than revolutionary.

REID ASHE
Miami Beach, Fla.

Reid Ashe is chairman and chief executive officer of Viewdata Corp., the videotex subsidiary of Knight-Ridder.

Lowenstein and Aller optimistically write that the success of videotex depends "only" on inexpensive terminals, cheaper charges for phone lines, and greater public awareness of videotex's many advantages. Actually, that happens to be an extremely tall order.

Furthermore, the French success with videotex telephone directories does not portend the acceptance of videotex in the United States. Anyone who has ever attempted to use directory assistance in France knows how sorely videotex was needed: information is much more difficult to acquire in that country than it is here.

Videotex will not catch on in the United States until the cost of acquiring data by conventional means becomes higher than the cost of videotex, which entails terminals, modems, line charges, and a provider's fee. That time may not be too far off—perhaps the mid-1990s. But videotex will probably never be truly a mass medium.

People like to interact face to face—as banks have found out in their efforts to do away with human tellers.

BERT COWLAN
New York, N.Y.



THE CAREER OPTIONS OF ENGINEERS

In "Up and Down the Dual Ladder" (August/September, page 12), Samuel Florman neglects some of the more serious problems that can arise when engineers move into management. Some engineers will be unsuited for managerial work, and their failed attempt will cause a setback for both them and their firms. Worse, most of those who do succeed will fail to reach the higher levels of management, since few high positions exist. What happens to such engineers? Those who continue for more than a few years tend to become protective of their positions; they stop innovating and growing. And those who return to technical work find that their skills have deteriorated.

Solutions do exist. For example, some engineering firms whose work is interdisciplinary and constantly changing have adopted a structure that facilitates forming and re-forming teams. This allows technical people to shift into and out of key management positions.

RAY W. MAYHEW
Columbus, Ohio

Samuel Florman seems to be saying that "it's an unfair, tough world, so accept it. Be satisfied with doing a job you like well, and let the money, prestige, and other honors go to those who can't enjoy their jobs." I find his attitude paternalistic.

Engineers do not necessarily have to become managers to receive rewards. Engineers, or engineering teams, can receive royalties for their inventions and developments—in exactly the same way that songwriters, authors, and independent patent holders do.

JOHNNY O'NEAL
Santa Ana, Calif.

SCIENCE FOR HUMANKIND

Michael Riordan sorrowfully observes that "once upon a time, U.S. particle physics knew no equal in the world" (*Books and Comment, August/September, page 16*). I thought that physics, like other scientific endeavors, was an international effort for the benefit of humankind. Had there not been physicists of all nationalities in the past, there would be no particle physics for the United States to crow about. Why this nationalistic fervor? What if the Manhattan Project had been restricted to American physicists?

FRANCIS E. CSENDES
Jupiter Inlet Beach Colony, Fla.

The author responds:

One of my intentions in writing the review of *The Particle Connection* was to question the nationalistic fervor you complain of, which unfortunately seems to be creeping back into American particle physics. Mr. Csendes is not the only reader to make such a comment, so perhaps the irony of my opening statement did not come through. If so, I apologize and ask you to reread the *entire* review.

REGULATION FOR BANKS

In "Preventing the Next Bank Panic," Lester Thurow may have built a case on perceptions that need clarification (*July, page 12*). Multi-state, multi-level bank regulation is fine-tuned to a banking structure that technology and market factors alike have all but destroyed. I would have thought that most observers of the changing banking scene would call for more relevant regulation. This regulation would recognize that market segmentation has largely vanished, that the financial-services industry is one whole piece of cloth, and that protection of individual product lines will simply no longer work.

The truth is that the previously well-designed banking system and its regulatory superstructure simply began to come apart at the seams in the seventies. Blame it on what you will, but the fact is that we

find ourselves having to begin again. First we must understand the new financial system in its international context, and then we must develop the rationale, the rules, and the equilibrium state for steady growth. Economists have a necessary contribution to make in today's marketplace. Tears shed on the altars of ancient regulatory temples do no real good, however much comfort they may give those who worship the past.

CHARLES J. STOKES
Bridgeport, Conn.



THE POLITICS OF FETAL PROTECTION

In "Who Do Fetal-Protection Policies Really Protect?" (*October, page 12*), Thomas H. Murray has missed a crucial point about protecting the fetus. The damage to mother and fetus from the same chemical is likely to be radically different because of differences in their stage of development, their size, and their ability to metabolize the agent.

Also, men produce sperm throughout their reproductive lives, so even if one "set" of sperm is damaged, they may be able to produce normal sperm later. Women, on the other hand, are born with all their eggs. This may help explain why more attention has focused on female reproductive hazards.

DEBYE FOUTCH
Caledonia, Miss.

The author responds:

Ms. Foutch seems to fear the effects of "occupational thalidomides"—agents essentially harmless to adults yet devastating to fetuses. However, the genetic mechanisms of mutation and cancer appear to be strikingly similar, so if something is killing, disabling, or deforming fetuses, it is probably harming adults as well.

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Ending the Bends

The monotony of factory work is not only mind-numbing; it is also dangerous. Stooping, bending, twisting, and reaching hundreds of times a day, thousands of times each year, can lead to "cumulative trauma" injuries such as tendonitis and back pain. Assembly-line tasks "can tear people down early so that 20 or 30 years into their working lives they become disabled," says Don Chaffin.

Chaffin suggests more extensive application of "ergonomics," which is the art and science of making machines suitable to people. "I really believe that a good ergonomics program can reduce by at least one-third the costs of injury, illness, and absenteeism," he says. As head of the Center for Ergonomics at the University of Michigan, he is midway through a four-year, \$2.4-million-dollar contract with Ford Motor Co. to redesign factory equipment, tools, and procedures.

Chaffin and his student and faculty co-researchers have spent more than 3,000 hours at Ford plants in the past two years. They've been in 12 of Ford's 30 Body and Assembly Division plants, and they have studies in progress in St. Louis, Mo.; Dearborn, Mich.; and several other sites.

The researchers interviewed production workers, videotaped them at their jobs, and studied plant medical records. Then they devised computer simulations to determine which jobs caused unnecessary straining, stretching, and bending. At the St. Louis plant, which produces the Aerostar van,



Michael Kehres' work station in Ford's Lima, Ohio, plant is "ergonomically" sound, minimizing the physical stress of his job.

researchers helped design a new assembly line. In Dearborn and other cities existing operations were modified.

Most of the changes they suggested were relatively simple: raising a conveyor belt a few inches to reduce stooping and bending; introducing hoists and supports to relieve the strain of using power tools; changing floor surfaces to reduce leg fatigue. A computer analysis of the St. Louis assembly line showed that if racks of engines were raised just 17 inches from the floor, employees could work more easily and efficiently. The work stations were redesigned accordingly. "Anyone working here now that it's done would feel the improvement in their back and legs,"

says Ed Childrey, an engine assembly worker.

New Ways of Thinking

Implementing ergonomic principles, says Chaffin, relies less on new technology than on new ways of thinking. He himself developed new ways of thinking in the early 1960s, during his technical training at General Motors Institute. He was required to work in several manufacturing plants, helping a high-seniority employee in each. But he estimates that only 3 or 4 percent of American engineering students even take a course in ergonomics.

"Engineers today," he says, "are hired right out of school and they go right into man-

ufacturing process design. They continue in that mode with no understanding of the human impact of the machines they are designing."

To help set matters straight, the Center for Ergonomics has offered continuing education courses for the past two years. Of the 850 Ford employees attending, most have been managers or engineers, but about 10 percent have been union representatives and production workers—a group that must be involved in factory design, says Chaffin.

"People actually on the shop floor can understand these problems much better than engineering and management people," he explains. "They have the best knowledge of what is causing problems and how they can be corrected."

Representatives of the United Auto Workers (UAW), the union that represents hourly workers at Ford, sit on a national advisory panel for the ergonomics research project, and members of local UAW unions can influence what happens at their own plants. The 1984 Ford-UAW contract states that the ergonomics study is one example of continued efforts to improve working conditions and reduce health-care costs.

UAW vice president Steve Yokich, head of the union's Ford Department, believes Ford's attention to ergonomics is long overdue. But he and other union officials are impressed by Ford's willingness to accept job-design ideas from shop-floor workers.

Medical Research— building a healthier future

If you've ever been treated for high blood pressure... heart disease... diabetes... or almost any health problem, medical progress based on research has already touched your life.

Because of medical research, polio no longer strikes in epidemic proportions every summer. Today about three-quarters of patients diagnosed as having Hodgkin's disease will survive five years or longer—as opposed to less than half twenty years ago. Current treatment options for people with heart disease and high blood pressure include medication that helps the body's natural regulators to control blood pressure and volume, enabling the heart to function with less strain.

Scientists are now working on new ways of treating such devastating afflictions as heart disease, cancer and Alzheimer's disease. They are testing new enzyme inhibitors that may control or reverse the late complications of diabetes. Forthcoming breakthroughs in understanding biological processes and treating disease may change the quality and perhaps the length of your life.

Medical research leading to such results takes years of patient, often frustrating experimentation by many different teams throughout the public and private sectors of our scientific community. The tasks involved are not simple.

Advances in research stem from a partnership that includes federal agencies such as the National Institutes of Health (NIH), universities and teaching hospitals across America, and private industry laboratories. Each partner often works independently to acquire knowledge and test new concepts. They must build on the knowledge developed in all laboratories, and they often coordinate efforts in their search for answers.

Whether an idea originates in a university laboratory or starts with basic product research carried on in the private sector, important findings percolate through the entire scientific community, where each new finding serves as a building block to establish a deeper under-

standing of what we are and how we function.

Medical research is an expensive process. It needs steady funding for equipment and personnel—even when progress is slow. Government and industry often work with university-based scientists and the medical profession not only in the acquisition of new knowledge and the development of new treatments, but also in funding these advances.

Now more than ever, we all must do our part to help keep the flow of discoveries active and ongoing. If funding for medical research is reduced, major advances in knowledge about some of the most dreaded diseases facing us today could be delayed for years to come.

What can you do?

- *Speak up.* Let your legislators know that you want funding of biomedical research by NIH and other government agencies to be kept at the highest possible levels.
- *Contribute* to voluntary health organizations supporting disease research.

Research-based pharmaceutical companies such as Pfizer are also increasing their financial investment in research. For instance, in 1984 alone, pharmaceutical companies in the United States spent over 4 *billion* dollars on research and product development.

At the same time, we at Pfizer realize the importance of committing more than money to research. As a partner in healthcare, we are continually working to discover new ideas, test new concepts, and turn new understanding to practical and beneficial uses. Now we are working harder than ever to make sure that this nation's medical research effort receives the attention—and funding—it deserves.

For more information on the future of medical research in America, write to Health Research U.S.A., P.O. Box 3852 FR, Grand Central Station, New York, NY 10163.



PHARMACEUTICALS • A PARTNER IN HEALTHCARE

Local union members are impressed, too. Says Bill Porter, a 36-year Ford veteran who is a UAW health and safety representative at the Dearborn stamping plant, "Everybody is really pleased with the whole process." Porter attended the Center for Ergonomics courses and serves on the ergonomics committee at the Dearborn plant. "It used to be they didn't listen to the production worker," he remembers. "Now, not only do they listen, but we can see changes being made."

Those changes have done more than reduce Ford's health-care costs. "Any time you've got an operator more comfortable at a job," says Ken Goff, a manager at the Dearborn plant, "they're going to do a job better, faster, and at higher quality." In one case, where a conveyor belt was raised a few inches so that carpet installers didn't have to reach as far, the fit of carpets to the automobile floor improved noticeably.

Thus ergonomics seems to yield benefits for everyone—workers, consumers, and the company. According to Chaffin, however, his work with Ford doesn't yield the hard scientific data needed to prove it. The problem, he says, is that so far each of the redesigned jobs have affected only a few workers.

He expects that his new job-design study of upholstery workers finally will provide the proper data. At one Ford plant in Michigan, more than 1,000 upholstery workers sit in the exact same position using the exact same equipment. Chaffin and his research team will seek ways to reduce the workers' arm and wrist strain.

UAW officials are already convinced of ergonomics benefits. Says Bill White, who sits on the national advisory panel for the Ford project, "If you keep doing these things in years to come, we are going to have healthier members."—Roger Kerson □

Memory Slugs

Important clues to one of life's most difficult secrets—how the brain records and stores memory—are emerging from experiments on the sea hare, *Aplysia*.

Eric Kandel, James Schwartz, and their colleagues at Columbia University's Center for Neurobiology and Behavior chose this homely, ink-squirting marine slug because its nervous system is relatively small and simple, and because its nerve cells are relatively easy to isolate. The findings, which appear to open a new era in brain research, are perhaps leading to an understanding of how memory works at its most fundamental level—what happens molecule by molecule as memory is created. In time, the work might lead to treatments for serious human brain disorders such as Alzheimer's Disease, now the fourth leading cause of death among Americans.

In some of their experiments, the Columbia scientists "train" *Aplysia* by stimulating it first with a gentle touch, then with a small electric shock. The shock makes the animal react much more strongly the next

time it is touched, vigorously retracting its fleshy gill and siphon. Depending on how often the touch/shock experience is repeated, the small, slimy animal "learns" the painful connection for minutes, days, or even weeks.

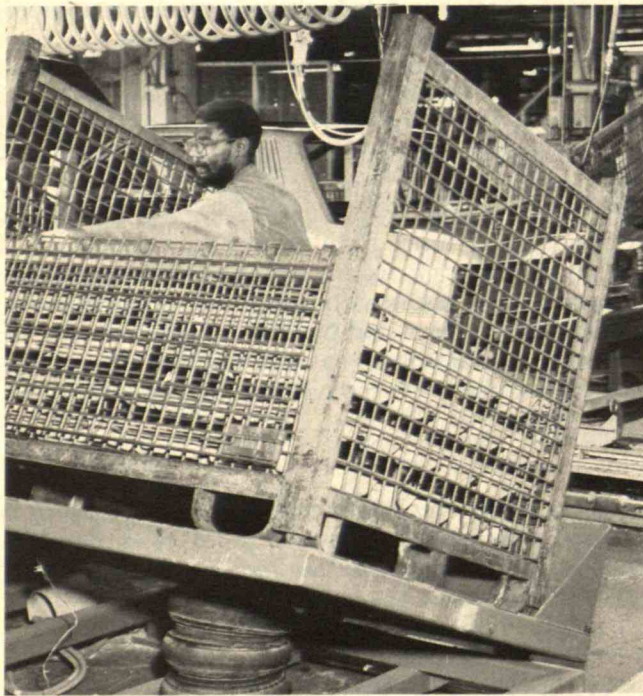
In other experiments, nerve cells taken out of *Aplysia* and grown in laboratory dishes show that the synapses—the junctions between nerve cells—become larger and change in shape as long-term memory develops. Apparently, the result is that more of certain chemicals, called neurotransmitters, can leap the small gaps between the ends of cells' nerve fibers, thereby improving communication between those cells.

The researchers go on to suggest that the brain's basic network of nerve cells is complete at birth, but that as the animal matures and experiences its environment, the busiest circuits are upgraded, improving the speed and efficiency with which they handle information.

Such speculations correspond to those of a German researcher, Niels Jerne, who has said that the nervous system and the immune system might work in similar ways, employing a biological mechanism central to evolution. Just as the nervous system comprises numerous circuits that may or may not ever be upgraded, the immune system manufactures a huge variety of cells whose disease-fighting genes may or may not ever make their own kinds of disease-fighting agents, called antibodies. Specific genes in the immune system are "turned on," making antibodies only when the body must defend itself against specific diseases. The remaining genes lie dormant, ready to be called into action.

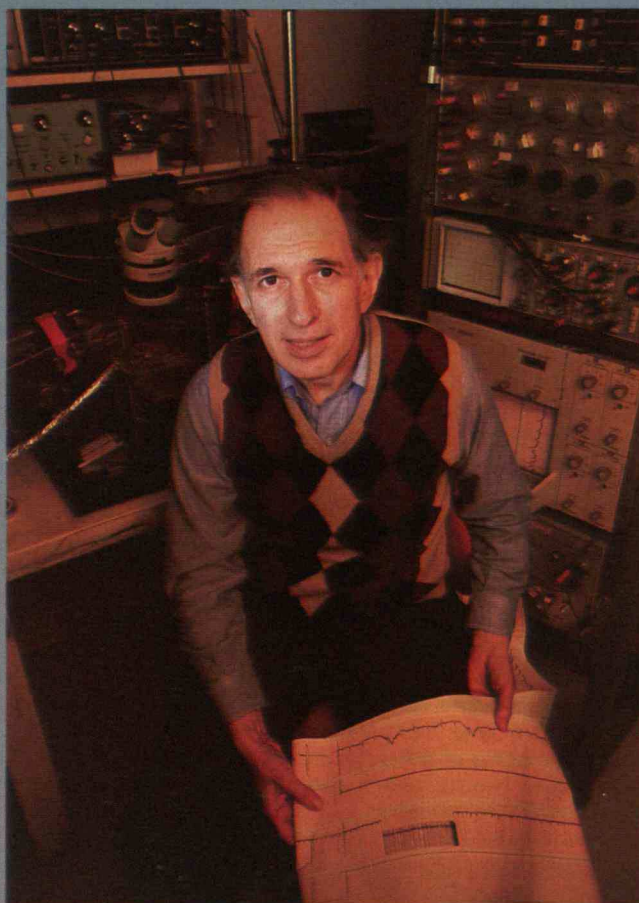
The Columbia University

Nathaniel Winston finds that reaching the bottom of the barrel is easier when it tilts forward. His Dearborn, Mich., plant was the primary research site for a project to make machines more suitable for workers.





Eric Kandel heads a Columbia University project that could create a mini-revolution in neurobiology. The project's research into memory focuses on the small, simple nervous system of the sea hare *Aplysia* (above).



research shows that long-term memory in particular resembles immune-system activity because it is created by turning on specific genes in the nuclei of nerve cells. The genes then make new proteins, constructing the new channels in nerve-fiber endings through which additional neurotransmitter chemicals flow.

In fact, since long-term memory is controlled by genes and helps the animal adapt to its environment, the capacity for long-term memory can be considered as a phase of an individual's development. Kandel explains that the change in synapse

size and shape engendered later, when long-term memory actually forms, is "similar to a step in the differentiation of the organism." He says his team's findings also indicate "that genes—a very limited number of genes—can be regulated by experience."

In a series of experiments reported late last year, the Columbia researchers tested some of their hypotheses about long-term memory. First, they induced "trained" and "naive" sea hare nerve cells to grow in laboratory dishes and form working synapses. Then, after dosing the cells with neurotransmitter chemicals to mimic a learning

experience, the researchers found that the cells reacted as if they were still working inside the whole animal.

By using an electron microscope, the researchers could see that active zones—the places on nerve fibers where channels for additional neurotransmitters are created—were indeed larger and more numerous on cells "trained" cells than on "naive" cells. In addition, by treating the cells with chemicals that keep genes from making new proteins, the experimenters were able to block long-term memory. "This suggests that genetic processes do lie at the root of long-term memory,"

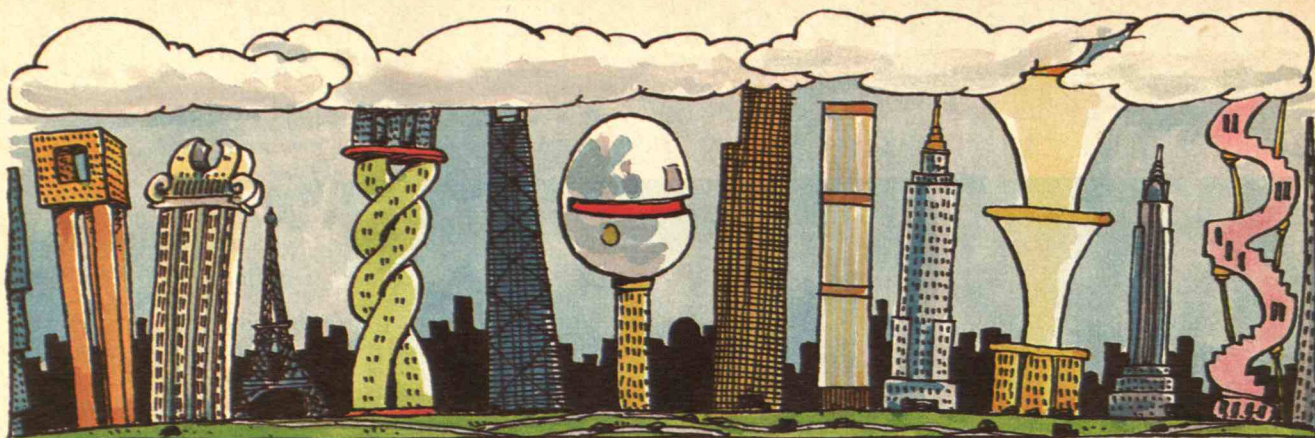
says Kandel.

Short-term memory, in contrast, operates through an entirely different mechanism at the molecular level, even though it is formed within the same cells as long-term memory. Short-term memory seems to involve modification of already existing nerve-cell chemicals, rather than the production of wholly new proteins. Kandel finds that short-term memory is linked to accumulation of the chemical cyclic-AMP in the nerve cell. As a particular nerve cell gets used over and over again, the amount of cyclic-AMP increases, priming the cell to react more strongly and quickly to the next event. When activity slows, the levels of cyclic-AMP begin to decline and short-term memory disappears. "Cyclic-AMP is the time-keeping system in short-term memory," Kandel says.

Other scientists are divided on Kandel's interpretations of his results, but most agree that the Columbia University team is working at the leading edge of neurobiology. For example, Larry Squire, in the University of California, San Diego, psychiatry department, says Kandel has created "a mini-revolution in neurobiology," illuminating "some general principles for memory [that] are, in a sense, going to be biological universals."

Even so, two fundamental questions remain unanswered. First, what is the chemical substance—the signal—that turns the genes on and off during formation of long-term memory? And second, which genes are involved? The answers—which may come soon, given the pace of biological research—are crucial to many practical applications of the Columbia team's work.

—Robert Cooke □



In the 100 years since the first steel-framed, internally supported building was completed for the Home Insurance Co. in Chicago, the skyscraper has become the icon of the city worldwide. Tall buildings make cities compact and convenient. And skyscrapers are "among the most compelling visual experiences architecture can provide," said *New York Times* architecture critic Paul Goldberger, keynoter at the centennial conference of the Council on Tall Buildings and Urban Habitat (CTBUH) in Chicago in January.

But Goldberger was not without criticisms. These "prima donnas" among buildings, he said, often "shriek excess at us," defying taste, judgment, and aesthetic balance. Fred Foote, partner in Mitchell Giurgola Architects of Philadelphia, similarly deplored "egonomics"—the competition to create distinctive new buildings that appeal to tenants' egos instead of their instincts for rational, aesthetic use of space. And Professor Leonard I. Ruchelman of Old Dominion University has a special complaint against buildings that "turn their backs" to the streets—for example, Detroit's Renaissance Center with its hard-to-find entrances and mirrored walls.

Consultant I. A. Naman of Houston focused on the skyscraper's vexing technical problems. There is as yet no

Tall-Building Centennial: The Rise of "Egonomics"

good, energy-efficient solution to the problem of temperature control and ventilation. Excessive infiltration of outside air (and sometimes rain) through walls and windows is a common problem; so is excessive moisture inside the building (except when air-conditioning is in use). Today's flashy exteriors often preclude effective insulation, and many large buildings are extravagant of water and electricity. Naman proposed recirculating sanitary systems using nonflammable, nontoxic liquid to cut water consumption by half. And sensors that turn off lights in unoccupied rooms would save electricity. (He estimates that keeping buildings aglow for cleaning accounts for 15 percent of their total energy consumption.)

Fires in tall buildings are a different kind of problem, said Margaret Law, a safety expert with the Ove Arup Partnership, London. We know how to build fire-resistant structures, control fires, and help occupants escape. What's lacking, in her view, is a sense of how much we should invest to protect the life and property a building contains. Though more money is being spent on fire safety in skyscrapers than ever before, said Law, "most fire engineers would hesitate

to say that it is being spent in the most effective way." For example, we lack a comprehensive model that evaluates tall-building fire-safety systems—detection, alarm, smoke management, escape route layout.

Boxes, Towers, and Cubes

But problems like these will not stem the tide of tall-building construction, nor did they dampen the enthusiasm of the 500 skyscraper designers, builders, and owners at the Chicago conference.

A database maintained by CTBUH now records a world total of 5,479 tall buildings—structures of 10 stories or more whose internal framework carries the weight of everything, including exterior walls. Most such buildings are in the United States, where a succession of them have held the title of world's tallest. But the skyscraper is by no means an American monopoly: CTBUH lists over 150 buildings in Kuala Lumpur, Malaysia, for instance. And Bill P. Lin of the National University of Singapore told the conference about that country's prodigious effort to house its burgeoning population: a series of 12-story buildings, each containing 132 apartments, has been built at the rate of one every

seven days there.

Technology now places almost no limits on architects' imaginations. New materials replace the familiar brick, stone, and concrete of the 1930s and 1940s, and computers can help engineers deal with complex and unconventional structural systems. The result has been glass towers, bronze boxes, twisted aluminum shafts, shining mirrored tubes, chippendale-topped cubes—a cacophony of shapes and textures.

Moreover, design strategies for tall buildings are by no means exhausted. Engineer William J. LeMessurier of Cambridge, Mass., assured the CTBUH that he could plan an efficient structural system for a half-mile-high tower in which 50,000 people could work. And only ten days before the CTBUH symposium, developer Donald S. Trump proposed a skyscraper community—to be named Television City—for 20,000 people on Manhattan's west side.

No Towering Infernos

Goldberger admitted that a megastructure such as Television City might be a spectacular way to begin the second century of the skyscraper, but he called Trump's proposal a typical example of "technical ability completely outpacing common sense . . . a science fiction nightmare." Another case of "addiction to tech-

An empty ambulance leaves a N.J. chemical plant after a 1984 accidental release of Malathion.

nological materialism, not to the things that make a city liveable."

It is not that Goldberger thinks all skyscrapers unfriendly. Indeed, he pointed out that the mixed-use "social skyscraper"—offices, hotels, apartments, and stores all in one complex—gives both occupants and neighbors a full range of social opportunities.

People who live in the growing number of such developments have "high levels of satisfaction" with life in general and their housing in particular, according to sociologist David Cooperman of the University of Minnesota. In fact, Cooperman told the CTBUH, the decade-old image of the skyscraper as a "towering inferno" has receded, and the era of environmental lawsuits against tall buildings is over. It's a startling indication of how quickly public perceptions can change, he said. He urged new psychological research so that future buildings can be more humane for those who live in them as well as those who live nearby.

Does regulation of skyscraper construction maximize the contributions of new tall buildings to urban cultures? Goldberger notes a dilemma: regulation might preserve historic aesthetics and keep populations from becoming unreasonably dense, but the result can easily be a "planned" skyline that lacks drama. Architect Harry Seidler, chafing under the new restrictions on architectural style in his native Melbourne, complained that creativity suffers when laws make bureaucrats "powerful arbiters of taste." Architect Foote agreed: despite his frustration with the products of economics, he said, good judgment is a better regulator than even the best laws.

—John Mattill □

New Jersey Cleans Up Its Act

In October 1984 an 18-mile-long toxic cloud from the American Cyanamid plant in Linden, N. J., drifted over Staten Island and 10 other communities. The cloud resulted from one of 15 chemical leaks that occurred in the area over three months.

Prompted in part by these accidents, N.J. Governor Thomas Kean signed the Toxic Catastrophe Prevention Act on January 8, 1986. The legislation, which is the first risk-management act in the country dealing with highly toxic substances, mandates that all plants using more than specified quantities of 11 chemicals have a risk-reduction program—either one the Department of Environmental Protection approves for them or one they

pay a consultant to develop. The program's risk assessment must include a description of all materials and processes used at the facility, an analysis of how accidents might occur, and a report on measures and alternative processes that could reduce the likelihood of accidents. Based on the assessment, the Department of Environmental Protection makes recommendations for reducing the risks. Though a court could overturn the recommendations, a company could be forced to adopt safer practices.

Up to 200 companies are immediately affected, says Donald Dieso, director of the N.J. Department of Environmental Quality. He adds that the list of chemicals the law covers could grow to 100 or more in the next 18 months, and that the number of affected companies could reach 800. The cost to each company would average \$100,000 per chemical, according to the N.J. Chemical Industry Council (CIC).

Dieso remarks that the cost depends largely on how much a facility already spends on safety measures.

Despite the costs to its members, the CIC supported the bill. Norman Miller, a staff member of the state legislature, says, "They feel that they need to clear up their public image. There have been not only the most obvious experiences at Bhopal and Institute [West Virginia] but a whole range of less catastrophic air releases in our state, and the industry was on the defensive." Peggy Ballman, assistant director of the CIC, asserts, "Our support shows that we are committed to trying to regain public confidence." She says, "Any facility that uses one of those 11 substances . . . should have some sort of risk-management program."

A National Problem

While the risks may be greater in New Jersey with its large chemical industry, the tragic



image of Bhopal is spurring public officials across the United States to reconsider existing safeguards. A December 1985 Environmental Protection Agency (EPA) study reported 6,928 chemical accidents causing 138 deaths, 4,717 injuries, and the evacuation of at least 217,457 people between 1980 and mid-1985. A spokesperson for Industrial Economics, Inc., the lead consultant on the study, told the *New York Times* that because the EPA study used incomplete records, the actual figures could be three times higher.

However, according to a July 1985 report by the Congressional Research Service, "there are currently no U.S. regulations covering the design and operation of chemical plants that are intended to prevent the accidental release of toxic chemicals such as happened at Bhopal."

Both the chemical industry and the federal government have come up with solutions that companies could adopt voluntarily. To restore confidence in the industry, the Chemical Manufacturers Association (CMA), whose members produce 90 percent of industrial chemicals, initiated its Community Awareness and Emergency Response (CAER) program. CAER is designed to improve public knowledge of what chemicals are used in local plants. Another of CAER's goals is to integrate plant emergency planning with that of local officials.

The EPA's solution is the Chemical Emergency Preparedness Program (CEPP), in which communities organize committees of local citizens. These committees assess the risks from local industries and plan emergency re-



Left: The lid was blown off this tank of Malathion. Right: Workers pick up soda ash used to destroy the effect of the spill.

sponses in case of an accident. In February 1985 Jack McGraw, then EPA's acting assistant administrator for solid waste and emergency response, told the U.S. Senate Committee on Environmental and Public Works, "I think as individuals we have to be able to assume some level of responsibility. If we live in a community, we ought to know what some of the emergency procedures and action plans are."

Many critics find the EPA program lacking. According to Fred Millar, director of the Nuclear and Hazardous Waste Transportation Project of the Environmental Policy Institute, "The Reagan administration didn't want to look like they were doing nothing in response to Bhopal, so this EPA program is about the best the Reagan administration could come up with." At a hearing in the New York State attorney gen-

eral's office, Millar said, "This program [CEPP] has no teeth, since it is purely voluntary, not regulations; it has no incentive for communities, since it is not federally funded."

Meanwhile, Congress is debating extending the Superfund Act, which provides for cleaning up hazardous waste sites; some proposed amendments would force EPA to plan for emergencies. Amendments introduced by Senator Frank Lautenberg (D-N.J.) target facilities employing chemicals on a list that EPA would publish. The facilities would be required to report the on-site quantities of those chemicals to the state governor, and local planning committees appointed by the governor would then prepare emergency response plans. The amended bill to extend the Superfund Act is presently in conference, but controversy over how to fund the

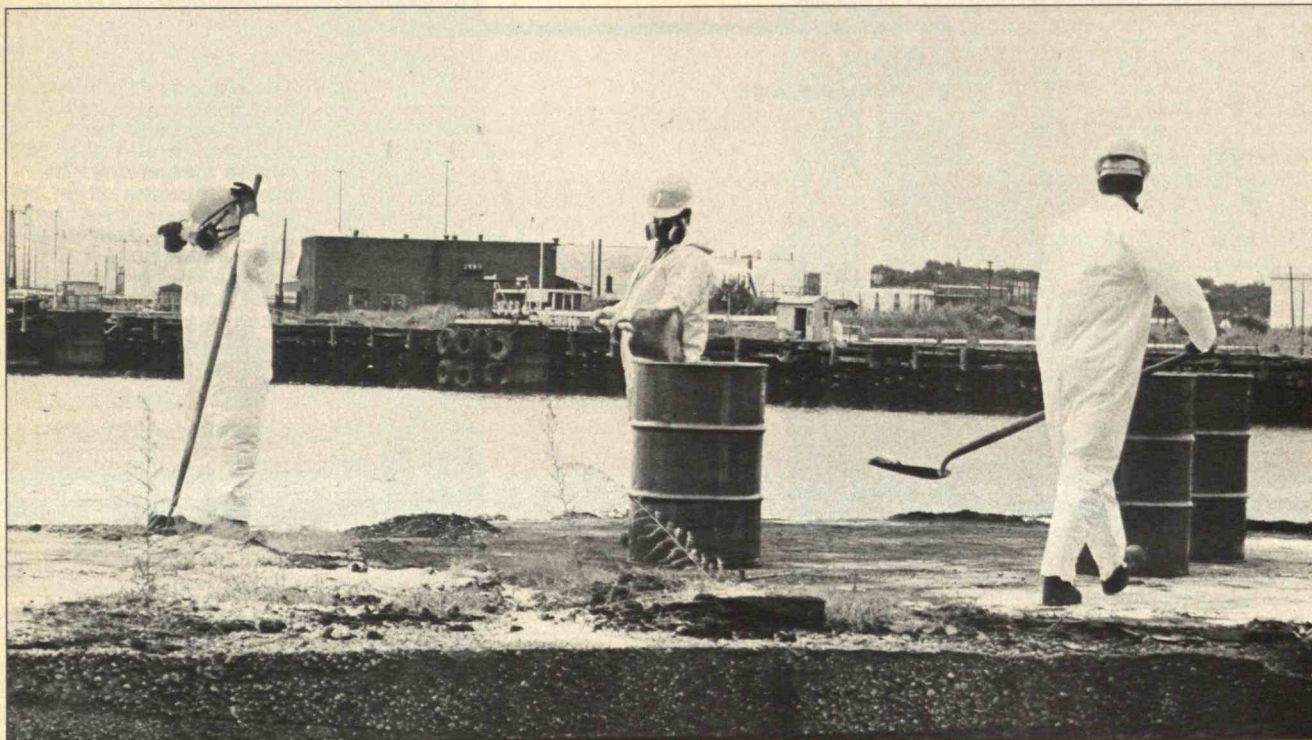
whole program may delay passage indefinitely. If the bill does pass, Lautenberg's amendments are likely to remain part of the bill since the House and Senate versions of it contain similar language.

Too Little, Too Late

George Tyler, assistant commissioner for environmental management and control of the N.J. Department of Environmental Protection, thinks that emergency response preparations, no matter how strict, are insufficient: "Once an emergency release occurs, in many cases, it is over quickly and no emergency response program, no matter how sophisticated, can prevent public exposure of whatever was released. . . . It is imperative that the release of large quantities of highly toxic chemicals be prevented in the first place."

Millar agrees. He looks to initiatives such as the N.J. Toxic Catastrophe Act to goad the federal government into action. "I don't think we will get decent congressional legislation until after there is a good deal of ferment going on at the state and local level, and then companies will want to have some sort of national uniformity," says Millar.

In Massachusetts, where Cambridge residents have asserted the right of their city to regulate research on chemical warfare agents, state representative Tom Gallagher has called for legislation governing the use of extremely toxic



substances. A task force chaired by Gallagher and state senator George Bachrach has recommended that facilities notify local governments before using certain chemicals to be specified by state health and environmental protection agencies. Local government officials could request that the state conduct a risk assessment and hold hearings in the affected community. The recommendations rely heavily on the existing wide-ranging powers of local health commissioners to regulate health risks.

An unusual aspect of the Massachusetts proposal is its attention to research institutions. They qualify for exemptions from the N.J. law and from the Massachusetts "right-to-know" law, which permits citizens to find out what toxic substances are being used where they work. Bachrach believes that "a hazardous chemical is haz-

ardous regardless of whose laboratory it is sitting in." But according to Robert Alberty, chair of the M.I.T. Council on Environmental Health and Safety and a member of the task force Bachrach heads, "Hazardous chemicals in the laboratories are used in small amounts that do not constitute a public health hazard in the sense that people outside the institution may be harmed."

While the CIC supported the N.J. bill, the Associated Industries of Massachusetts (AIM), a similar lobbying group, will oppose the Massachusetts proposal if it becomes a bill. Bill J. McCarthy, AIM general council, indicated that the program "would be still another layer [of regulation] that would be counterproductive."

Some states sponsoring legislation to protect the public from the hazards of extremely toxic chemicals go further

than risk reduction or management. In Michigan, state senator Phil Arthurs introduced a bill that would ban the production, use, or storage of methyl isocyanate (MIC), the gas released in Bhopal. The bill grows out of concerns that Nor Am Chemical Co., located in Muskegon Township, might produce MIC itself after Union Carbide stopped shipping the chemical last year. Nor Am, which used MIC to produce a pesticide, admits that production in Muskegon is an option it is considering.

Although local chemical companies oppose the bill, some local industries support it. For example, Quality Stores, Inc., a retailer with 40 stores whose corporate headquarters are in Muskegon, threatens to reconsider plans to expand in the area if MIC is produced at the Nor-Am plant. Arthurs' office hopes the bill will be ready for

Michigan's governor to sign this spring.

Roger Batstone, the industrial pollution control engineer of the World Bank, thinks that the national chemical industry may ultimately support risk-reduction programs. Batstone, who implements such programs for companies seeking World Bank funds for Third World projects, says, "What the chemical industry is not factoring into their equation are the high insurance costs, the high cleanup costs, and the lawsuits coming out of these things. If they start factoring these costs into their equation, they'll find it makes good business."

—Dan Grossman □

DAN GROSSMAN was a member of the Extremely Toxic Substances Task Force, which was appointed by the Health Care Committee of the Massachusetts legislature.

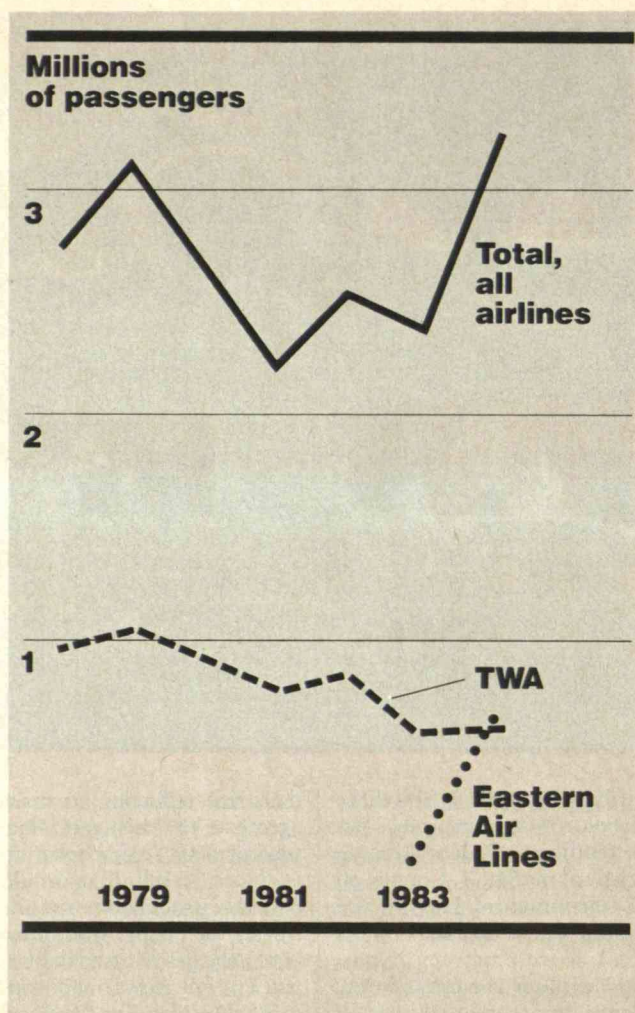
Airports at Risk

Deregulation has brought a new era of scramble-for-business competition and uncertainty to airport managements, just as it has to airlines. To beat the competition, airlines often change schedules and routes with little notice, and thus airport demand changes in the same way. The result is that deregulation threatens to saddle the U.S. with an inefficient and over-costly airport system, says Professor Richard de Neufville of M.I.T.

In the days of airline regulation, most airport authorities geared the size of their fields and terminals to local transportation demand—the number of people who travelled to and from the commercial or tourist attractions of the locality. But no more. To serve as many customers as possible in today's free-for-all, airlines designate "hubs," where passengers are reshuffled among connecting planes from many origins to many destinations. The number of passengers in and out of such a hub airport bears little if any relation to local transportation demand.

Furthermore, says de Neufville, since airport revenues are generally based on the number of landings and take-offs, airport managements now compete among themselves for hubs by offering capacious terminals at low rents.

Most hubs are dominated by a single airline. Thus an airport that expands to meet one airline's hub requirements is vulnerable to shifts in its business strategy or marketplace success. Consider, for example, the case of Kansas City, which used to be



The Kansas City Airport lost passengers between 1979 and 1983 for reasons unrelated to the region's economy. The problem began when TWA moved many of its "hub" connections from Kansas City to St. Louis. Traffic volume recovered only in 1984 when Eastern Air Lines began using Kansas City as a secondary hub.

the hub for TWA. Kansas City traffic dropped by nearly 15 percent between 1978 and 1983 when TWA moved many of its hub connections to St. Louis. Finally Eastern came to the rescue, choosing Kansas City for a secondary hub in 1983. The result: Kansas City traffic grew 34 percent in a single year.

The hub system contains another source of volatility, too. Some non-hub cities now have far less nonstop air service than they need. You can fly nonstop from Toledo, Ohio, for example, to only 10 destinations—none on the East coast or west of St.

Louis. So Toledo heads a list of "prime targets for new air services" compiled by Joseph P. Schwieterman of United Airlines and Professor Emeritus Frank A. Spencer of Northwestern University last year. If they come, those new air services may well replace service in some existing hub airport. The latter will be left with unused facilities and decreased income. If that scenario is replayed often enough, the U.S. will end up with an overdeveloped, inefficient, and costly airport system.

All this means that "investments in airport facilities

are riskier and the financing of airports likely to be more expensive," says de Neufville. Deregulation presents "a major challenge to the established processes for airport planning."

There have been no catastrophes yet. After a 1984 study, the Congressional Office of Technology Assessment concluded that the top 70 airports in the United States are in "good financial condition. There has never been a default on an airport bond issue," said OTA, and airports have the reputation of being "soundly financed and managed."

To maintain that good record, says de Neufville, two tough questions need answers:

□ How can an airport authority minimize financial risk without discouraging new business through over-conservative decisions?

□ In this era of deregulation, can any central authority be given the task of preventing one airport from expanding at the expense of an already-adequate neighbor? In other words, should the Federal Aviation Administration or some other entity be given national responsibility for airport planning?

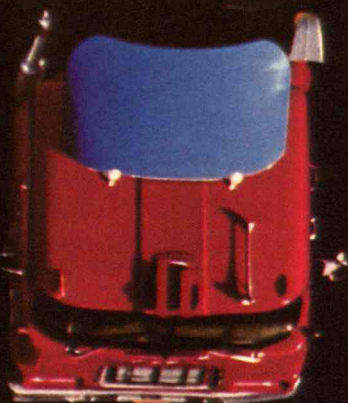
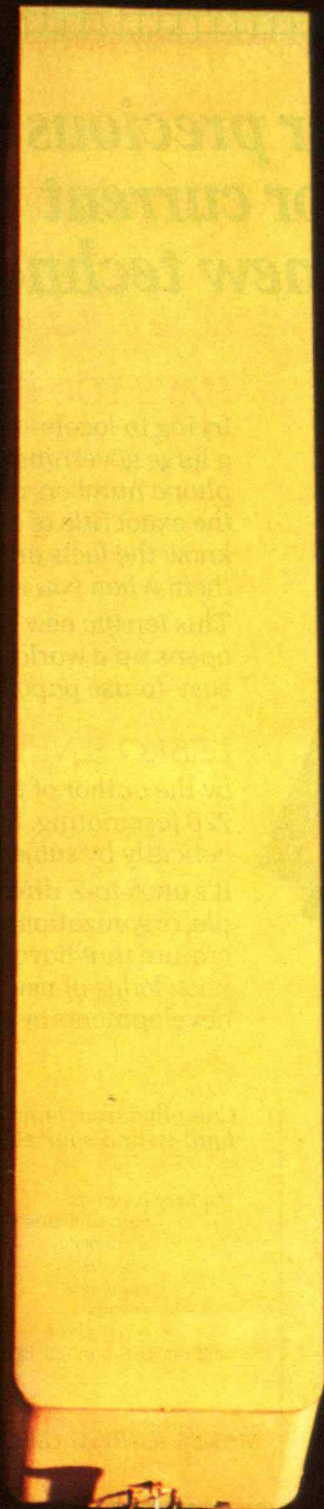
—John Mattill □

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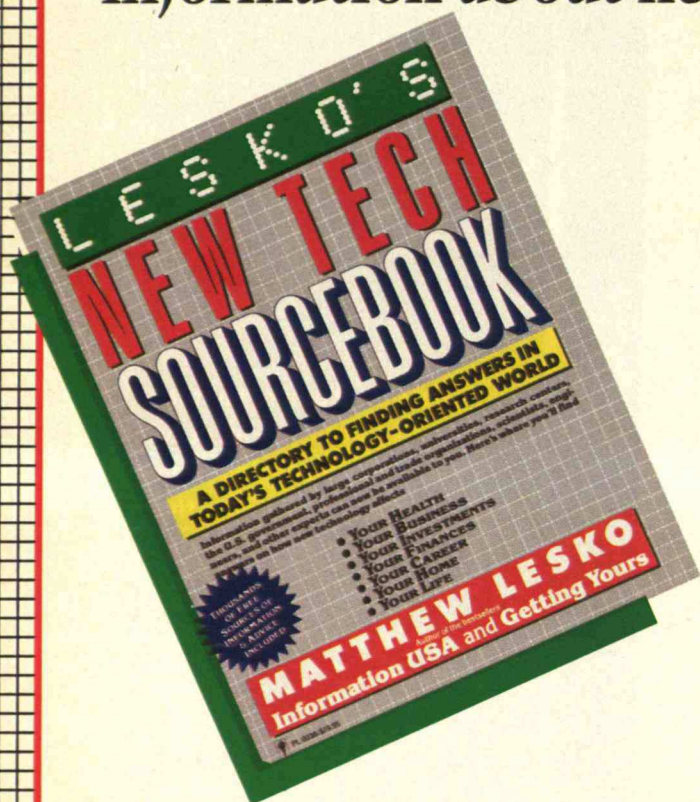


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The Biosphere and the Atmosphere: A Global Picture

HUMANITY is fundamentally changing Earth's atmosphere. We are increasing the atmospheric concentration of gases such as chlorofluorocarbons, which may attack the ozone layer that filters out the sun's ultraviolet rays. By burning coal and oil, we are building up high concentrations of heat-trapping gases such as carbon dioxide, causing the climate to become warmer (the "greenhouse effect"). We are also altering Earth's climatic system by chopping down tropical forests and allowing deserts to spread.

To predict the net effect of all these different changes, scientists need to understand how Earth functions as a total atmospheric, oceanic, geological, and biological system. Fortunately, earth scientists and ecological scientists finally are ready to work towards such an integrated understanding. The outcome may well be a new professional discipline that combines both sciences. Such a confluence would come none too soon.

Atmosphere and biosphere interact in several ways. For example, plants help regulate the mix of atmospheric gases by absorbing carbon dioxide and releasing oxygen into the air. Plants determine the roughness of the planetary surfaces over which the atmosphere flows. Plants affect rainfall by returning soil moisture to the air through transpiration. They also influence the planet's balance of solar energy by the way they absorb and reflect incoming sunlight. Conversely, the atmosphere provides water and nutrients for plants.

Life maintains the atmosphere in a state far from chemical equilibrium, notes James Lovelock, a self-employed British atmospheric chemist who helped design the Viking system, which looked for life on Mars. By generating oxygen, for instance, plants are constantly introducing that chemically active gas into the environment, where it reacts with other gases but never achieves a state of equilibrium with them.

Lovelock speculates that Earth systematically maintains an environment suitable



To understand how contemporary society is altering Earth's atmosphere, scientists from different disciplines must learn how living organisms and weather function as an integral system.

for life. He calls this the Gaia hypothesis (named for the Greek earth goddess) and defines Gaia "as a complex entity involving Earth's biosphere, atmosphere, oceans, and soil, the totality constituting a feedback . . . system that seeks an optimal physical and chemical environment for life on this planet."

Taking Life into Account

While few meteorologists would agree with Lovelock's theory that the biosphere manipulates the atmosphere, they now realize they do have to take life into account to know what the atmosphere is doing.

"We've reached the state in our science where the big problems that remain are too big to fit within atmospheric science," says John Eddy, a meteorologist with the University Corporation for Atmospheric Research, which runs the National Center for Atmospheric Research (NCAR) in Boulder.

By "big problems," Eddy means the climatic impact of clearing the tropical forests or increasing the air's concentrations of carbon dioxide and other heat-trapping gases. The more meteorologists look into these problems, the more they realize they need to know about such issues as how forests influence regional rainfalls and how lifeforms recycle carbon from the atmosphere. In the end, global weather systems, which determine climate, seem to depend to a large extent on plant and animal communities.

A case in point is that of certain marine microbes (coccoliths), which make dimethyl sulfide (DMS) gas. This gas seeps into the air, where it makes the sulfur dioxide that eventually becomes cloud-seeding particles. Ralph Cicerone, an atmospheric chemist with the NCAR, says these particles are one of the major factors in generating the clouds that develop over the ocean. Thus coccoliths could "represent a heretofore unconsidered, or poorly considered, leverage on Earth's atmosphere," Cicerone says.

Understanding the Whole Cycle

How, for instance, would these tiny microbes be affected if the climate grew warm enough to change ocean chemistry? Warmer waters would have slightly different salt concentrations. And any difference in salt concentrations would undoubtedly affect the coccoliths' DMS production and that, in turn, could change ocean cloudiness and affect climate and weather. To accurately anticipate what might happen, meteorologists need to know something about marine biology, and biologists need to know more about meteorology.

The increasing concentration of methane gas, which traps heat in the atmosphere, is also pertinent. In recent years, methane's atmospheric concentration, which had previously remained stable at 1.6 to 1.7 parts per million (ppm), has been rising 1 or 2 percent a year. Such an

Continued on page 71



ROBERT C. COWEN IS SCIENCE EDITOR OF THE CHRISTIAN SCIENCE MONITOR AND FORMER PRESIDENT OF THE NATIONAL ASSOCIATION OF SCIENCE WRITERS.

Gorbachev's Risk in Reforming the Soviet Economy

FOR those who like to argue about whether an individual can make a difference in history, the Soviet Union is the place to go these days. Since Mikhail Gorbachev assumed control in March 1985, he has replaced a large majority of senior party and government officials, sought to remold some of his country's most engrained social habits, and called for a fundamental transformation in the Soviet Union's economy and industrial processes.

As a long-time student of the Soviet economy, I was particularly eager to see for myself how effective these efforts have been. Given the fate of similar attempts in the past, I have to admit I was skeptical. My eagerness was further tempered by the realization that the Soviet government had twice denied me a visa. They never explained why, but I was led to believe that they had been displeased by some of things I had written and broadcast. Most of all, they had not liked the fact that I had met with and delivered lectures on the American economy to Soviet dissidents and to *refusniks*—Jews who have been denied permission to emigrate.

I was therefore quite dubious when the United States Information Agency (USIA), which I have consulted for in the past, indicated that it would seek a visa for me. The odds that I would be issued a visa fell even further when the State Department in Washington called with the message that Arthur Hartman, the U.S. ambassador to Moscow, had asked Georgi Arbatov, the director of the Institute of the U.S.A. and Canada, for his help in obtaining a visa for me. "What for?" scowled Arbatov. "So he can come and give more lectures to dissidents?"

Thus, I heard with disbelief from the USIA that not only had the Soviet government issued me a visa for January, but the visa had been approved in a record 10 days. Furthermore, the visa contained no stipulation that I was to avoid dissidents. Evidently, I was "the spirit of Geneva."

Once in the Soviet Union, I found that Gorbachev was indeed making something of a difference. In fact, there has been



Gorbachev's challenge is to stir the creative juices of Soviet industry without provoking social unrest.

nothing comparable for at least two decades and in some cases never. Gorbachev has fired, retired, or jailed more than 50 percent of the most senior party and government officials because of old age, incompetence, or corruption. Most of these officials had held their positions since the early Brezhnev days and had come to behave as if they had been born to their posts. They often ruled as little dictators in luxurious fashion.

Fewer Drunks in Moscow

Gorbachev has also taken on the challenge of changing one of the most basic Soviet behaviors—the daily and frequent consumption of alcohol. Although alcohol abuse has become more serious in recent years, its use as a release and a sign of manhood predates the Soviet era. Alcohol consumption has had a negative impact on almost everything in the Soviet Union, from the mortality and divorce rates to

industrial productivity.

According to Soviet surveys, about 25 percent of the factory workers in the Soviet Union used to come to work in the morning having already had a drink or two of vodka. To curb such excesses, Gorbachev has ordered that no liquor be sold or served until 2 P.M., and that the number of stores selling liquor be drastically reduced. That may explain why—when my wife and I went to dinner in the Uzbekistan Restaurant, one of Moscow's most popular restaurants, at 1 P.M. one day—we saw only one drunk in the restaurant. In previous years, there were several drunks at every table regardless of the time of day. The picture changed of course at 1:58 when—as at a wedding—the doors opened and waiters filed in with trays filled with cognac and wine. But at least the morning had been a sober one.

This restructuring of the Soviet way of life has its good and bad sides. On the bad side, the lines in front of wine stores have become enormous, upsetting not only the alcoholics who will stand in line no matter how long it takes, but also those who are not heavy drinkers and simply want to serve vodka to their guests.

To Gorbachev, these inconveniences are a small price to pay. In his view, curbing alcohol and enforcing discipline has resulted in an improvement in productivity. For example, while production in the petroleum industry before the crackdown was dropping by 4 percent monthly, by the end of 1985, production was dropping by only 1 or 2 percent per month.

Another positive result of Gorbachev's efforts is that there is now a whole new genre of jokes in the Soviet Union. As one Muscovite says to his friend as they stand in line in front of a liquor store: "We shouldn't complain that Gorbachev is a teetotaler. Can you imagine what would have happened if he were impotent?"

Seeing all of this firsthand, I had no doubt that Gorbachev has made a difference, at least in the Soviets' social and perhaps administrative behavior. What is less certain is whether he will be able to reduce the growing technology gap between the Soviet Union and the rest of the world in producing computers and other high-technology products. It is not just the United States, Japan, and Western Europe that are pulling ahead. Less significant economic powers such as Taiwan and Singapore have also outproduced the Soviet Union in high-technology goods. To be fair, the



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United States is also having problems competing with some of the same countries. But at least we continue to move ahead in R&D, if not in recapturing some of the markets for items such as mainframe and personal computers.

In an effort to spur technological innovation and improve productivity, Gorbachev has authorized a variety of experiments, many of them contradictory. On one hand, local factory managers—of chemical and automobile plants, for instance—are being given more authority over determining wages, product mix, and output in the hope that they will produce higher-quality goods. On the other hand, the power of some central ministries, such as those dealing with agriculture and machine tools, has been consolidated and increased in a bid to improve efficiency.

Previous experience shows that the effort to increase local manufacturing authority will not only be resisted by the ministries but by other central agencies such as Gosplan (planning) and Gosbank (banking). In all likelihood, these ministries will continue to press local factories to make what these agencies want.

To increase efficiency, Gorbachev has also decided to restructure the Soviet economic system so that less power is allocated vertically. For instance, he has created local economic units so that enterprises from two different ministries in Kharkov, a town in the Ukraine, can deal with each other on the spot rather than submitting all their negotiating documents back and forth through Moscow. However, such a reform could also dissipate power in Moscow, and, as previous efforts have shown, Moscow bureaucrats will probably seek to sabotage these reforms.

The Risk of Unemployment

In an even more daring move, Gorbachev has introduced the spectre of unemployment. Many ministry bureaucrats have been fired with little notice and a guarantee of only three months' salary. One rumor making the rounds in Moscow is that 4,000 people were fired during the restructuring of the agricultural ministries. In one leading research center, the Institute of World Economics and International Relations, 30 percent of the staff has been fired. Salary increases of up to 50 percent as well as the threat of additional firings will be used to encourage those who remain to increase productivity.

This process may extend to blue-collar workers as well. One economist has suggested that to significantly increase manufacturing productivity, as many as 13 to 19 million factory workers will have to be reassigned to the service sector. While such a move might indeed improve the output per worker hour, it also risks provoking unrest in a society where such things are not supposed to happen. There is no denying that the service sector in the Soviet Union needs vast improvement; services ranging from dry cleaning and appliance repairs to medical care remain woefully inadequate. However, this proposed influx of new workers to the service sector will not automatically improve the economy. To truly change the economy, Soviet workers must completely revise their attitude toward performing services, an activity they now hold in low repute. Thanks to Marx and Lenin, the heroes of the Soviet economy are the male factory workers and the female peasant farmers; the laundry worker gets no respect.

Gorbachev has accompanied his attempts at economic reorganization with calls for more candid discussions of the Soviet Union's problems. Shortcomings that at one time were not admitted are now debated openly on live phone-in programs on Soviet television. Admittedly the questions are prescreened, but it is still striking to hear economic officials asked why so much is spent on missiles rather than on tractors. In another instance a mother of two called in to complain that as part of one of the experiments, she had been fired and could not find a job in Moscow. There never used to be any public acknowledgement that unemployment was a problem in the Soviet Union.

The process of trying to stimulate productivity and innovation does carry a risk: some Russians may extend their new candor to the area of human, artistic, and political rights. Already some intellectuals such as the poet Yevgeny Yevtushenko have taken Gorbachev's call for equal discipline for all to demand an end to privilege for the powerful in the Soviet Union.

Gorbachev's challenge is to stir the creative juices of Soviet industry and agriculture without unleashing political demands for more democracy, which in turn could set off a backlash and abort the whole effort. He has raised the level of expectations for economic success, but—as others before him have discovered—that can be very dangerous. □



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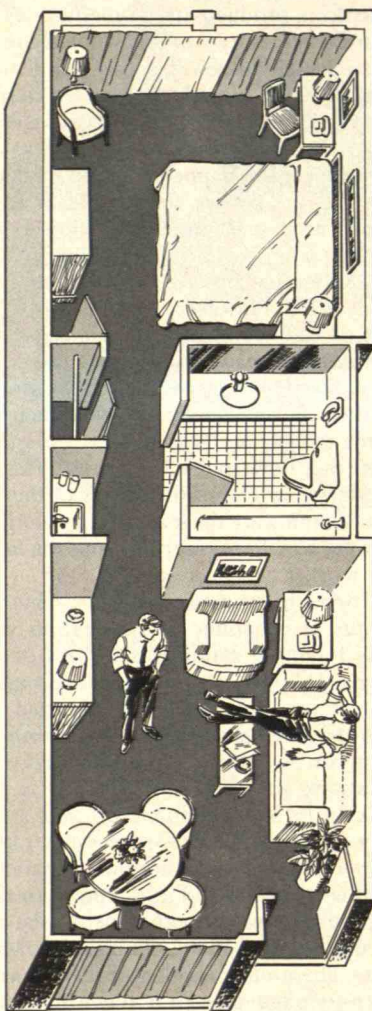
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BY NANCY K. RHODEN

Should Medical Technology Dictate a Woman's Right to Choose?



LEGAL observers have noted, some with alarm and some with glee, that *Roe v. Wade*, the landmark 1973 decision legalizing abortion, contains the seeds of its own destruction. This is because the Supreme Court held that once a fetus is viable—potentially able to survive outside the womb, albeit with artificial aid—individual states can choose to prohibit abortion unless the woman's health is at stake. In 1973, when fetuses ordinarily were not viable until after about 28 weeks (or seven months) of gestation, this limitation gave women a great deal of time in which to decide whether to continue a pregnancy. Today viability occurs at about 24 weeks' gestation, or the end of the second trimester, so women still have ample time. But what if dramatic medical advances someday make fetuses viable in the first trimester? Or what if artificial gestation techniques are developed that make fetuses viable from conception onward? If viability remains the cutoff point for elec-

tive abortions, such developments could render *Roe* an anti-abortion decision.

It is important not to sensationalize recent medical advances. Changes in the threshold of viability have occurred very slowly and gradually, and the threshold has been lowered by only a few weeks. These changes primarily result from improvements in the technology for managing respiratory difficulties in extremely premature infants that do possess some capacity for lung function. Lung development is usually the limiting factor in the survival of premature babies.

Absent the development of an artificial womb or other extraordinary technology not even in sight, many experts doubt that the threshold of viability will ever drop below 22 or 23 weeks because of the immaturity of fetal lungs and other organ systems. Thus, for the foreseeable future, medical advances will not severely threaten women's right to abort (although changes in the makeup of the Supreme Court might). So, one might ask, why should we bother about a problem that may never even materialize?

One reason is that even relatively small changes in the threshold of viability could threaten many abortions for fetal defects.

Amniocentesis, a procedure that can determine the existence of certain defects such as Down's syndrome, usually cannot be performed until the sixteenth week of pregnancy. Before that, there is not enough fluid in the sac around the fetus to remove and test safely. The results are typically not available until week 19 or 20. However, once chorionic villi biopsy, an experimental new test for genetic defects that can be performed in the first trimester, becomes standard, this problem should greatly diminish. However, the problem will not disappear, as some women will not seek prenatal care early enough for chorionic villi biopsy to be performed. Furthermore, the new test does not detect central nervous system defects, for which amniocentesis will remain necessary.

Small changes in the threshold of viability could also affect the group most likely to seek late second-trimester abortions—young teenagers, especially those of low socioeconomic status and little education. A teenager may be more likely to deny the possibility of pregnancy, and too frightened to seek medical help, until physical changes make the pregnancy undeniable. Poverty and lack of education

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Roe v. Wade, the 1973 decision *legalizing abortion, may contain the seeds* *of its own destruction.*

also make teens less able to locate medical care. Needless to say, teenagers are also the least able to cope with pregnancy, childbirth, and child-rearing.

But probably the most important reason for concern is a more theoretical one, related to the proper role of technology in shaping social policy. Because *Roe v. Wade* made viability the crucial dividing line, the limits of women's right to choose are now determined entirely by medical technology. Did the Supreme Court really intend that technology completely control the parameters of women's constitutional rights? In other words, did it intend that if the threshold of viability were miraculously reduced to 18 weeks' gestation, states could prohibit abortions after that time?

The Moral Relevance of Viability

The Supreme Court has emphasized viability not only in *Roe*, where it said that this limitation has "logical and biological justification," but in later cases as well. For instance, in one case decided in 1979, the Court upheld viability as the point when the state's interest in potential life becomes compelling, as opposed to a specifically designated time such as 28 or 24 weeks. The Court has even said that the time of viability must remain flexible to accommodate advances in technology.

The Court has not precisely spelled out what is so important about viability. The way in which viability is relevant is easy to discern, however. Before a fetus is viable, granting a woman the right to terminate her pregnancy will inevitably result in the fetus's death. The woman's right to autonomy cannot be protected without sacrificing the fetus. After viability, however, things are different. It is possible that a viable fetus could survive an abortion procedure, in which case it would undoubtedly suffer the perils of prematurity and would probably have been harmed by the abortion procedure itself. Moreover, if a fetus is removed by a lethal abortion method after viability, its death is no longer a necessary result of the removal, but is in some sense gratuitous. Past the point that a fetus could, if provided proper medical care, survive on its own, removal by either a lethal or a non-lethal method is morally problematic. Fetal viability therefore possesses some claim to moral relevance, and to constituting an appropriate upper limit on women's privacy rights.

But is the importance of fetal viability in the Supreme Court's analysis properly viewed as absolute? In other words, what if dramatic medical advances were to allow fetuses to survive so early in gestation that the viability cutoff conflicted with the fundamental principle of *Roe*—that women's right to privacy gives them a right to abort for a substantial portion of pregnancy? Would the viability limitation continue to control?

In examining this question, we should not ignore the fact that the Court initially selected viability as being important within a particular context. At the time of *Roe*, survivability coincided with late gestation. I believe that this masked the important underlying premise. This is the notion that a viable fetus is one that has reached a fairly late stage in gestation and looks very much like a baby, evoking the social and emotional responses that babies evoke. While this stage cannot be specified precisely, viability has until now been associated with the last third of pregnancy. If viability ceases to coincide even roughly with "late gestation" it loses much of its implicit, albeit unarticulated, support.

Preserving Women's Rights

Whatever one's views about abortion in general, there is far less social support for very late abortions, which are seen as uncomfortably similar to infanticide. People's psychological reaction to abortion of an eight-month-old fetus (viable with little or no medical technology) is probably far different from what their reaction would be, were artificial gestation technology ever developed, to abortion of an embryo that needed to be incubated for eight or nine months. Yet such an embryo would, technically speaking, be viable.

For that matter, embryos can now be transferred from one woman to another. If the second woman is viewed as "artificial aid," the embryo is viable for the few days when it can be transferred, or before it implants in the second woman's uterine wall. But abortion then seems no different from abortion after implantation.

Likewise, lack of viability would not necessarily change our reaction to abortion of late-term fetuses. If it were known that a particular fetus suffered from severely retarded lung development, such that it was not viable at eight months (though it would be at nine months), I doubt that even people who consider vi-

ability of overriding importance would be comfortable with abortion of this fetus.

The point is that the moral significance of viability depends on the general context within which *Roe v. Wade* was decided. Nothing in the Court's opinions suggests that the viability standard will continue to exert equal force as a legal precedent if the medical context changes dramatically. In fact, it would be extraordinary for the Court to suggest such a thing because it would be relinquishing its right to establish the balance between constitutional rights and state interests. The Court would be completely delegating this responsibility to the medical profession or, more precisely, to medical technology. But there is no reason for it to do this: the Court clearly has the power to reassess the importance of viability if the medical context changes and the viability standard begins to oppose, rather than support, women's rights.

If the medical context ever does alter in this manner, a judicial reassessment of the relevance of fetal viability would be based on principles similar to those upheld in *Roe*. As such, it should reflect, and be responsive to, the capabilities of new medical technology. Indeed, abortion law could look very different someday if researchers developed a safe, 100 percent effective drug to induce abortion that could be purchased without prescription. However, this sort of decision should not be ruled solely by technology. The Court need only recognize that viability's importance is tied to a specific context and that technology can shape, but should not control, women's constitutional fate.

The Court must recognize that while viability is a medical concept, viability as the dividing line for abortion is much more than this. As an ethical limit, it stands for the time when a fetus is just too much like a baby to be destroyed without compelling, health-related justification. If viability ceases to represent "late gestation"—admittedly a fuzzy, hard-to-define time, but surely not before the second half of pregnancy—then it has lost a substantial portion of its meaning.

Only a Court that elevated the letter of the law above its spirit would blindly adhere to the viability standard if the medical context were dramatically altered. Our Supreme Court has shown itself not to be such a Court. Thus, if the time ever comes, it can and should simply reassess the relevance of viability to abortion law. □

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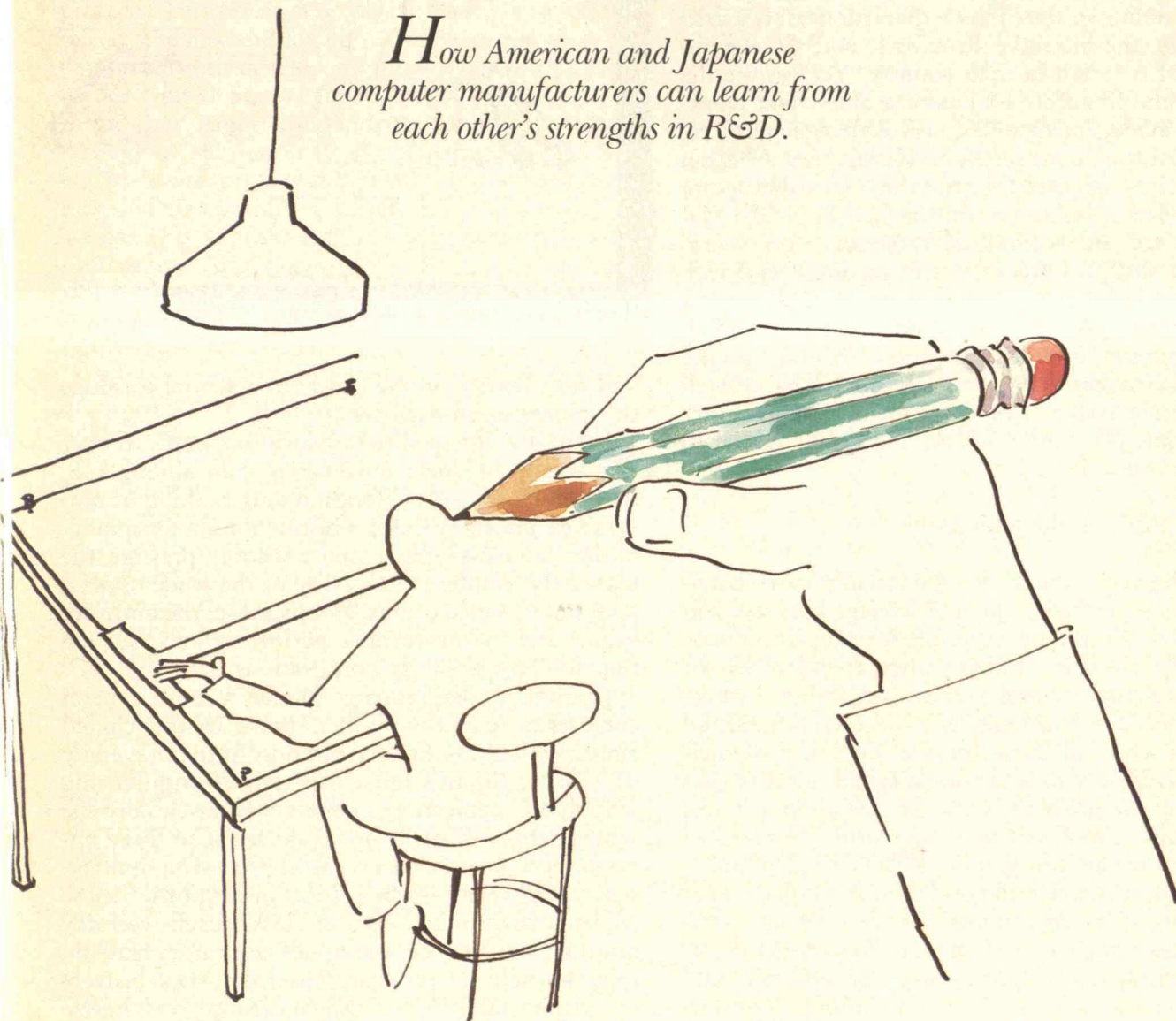
Computer R&D in the United States and Japan

FOR the technologies that undergird the "computer revolution," U.S. companies appear to have an edge in innovation, while Japanese companies seem to have remarkable success in incorporating innovations into products and moving them quickly into the marketplace. The United States continues to dominate in design-intensive, high value-added, and more profitable areas such as computer systems. However, Japanese success in producing high-quality products in areas such as semiconductors, disk drives, and computer peripherals contributes to Japan's current high-tech trade surplus with the United States. That success is based largely on the close link in Japan between design and manufacture.

In the highly competitive computer industry, therefore, Japanese firms are eager to improve their capacity for innovation. U.S. firms, for their part, want to improve their ties between design and manufacture. Both sides are looking closely at the way their counterparts across the Pacific organize their R&D processes to find out what, if anything, they can learn. Companies in both countries are also moving to internationalize their R&D. U.S. firms such as Digital Equipment and Data-General have developed design facilities in Japan; Japanese

BY D. ELEANOR WESTNEY AND KIYONORI SAKAKIBARA

*How American and Japanese
computer manufacturers can learn from
each other's strengths in R&D.*



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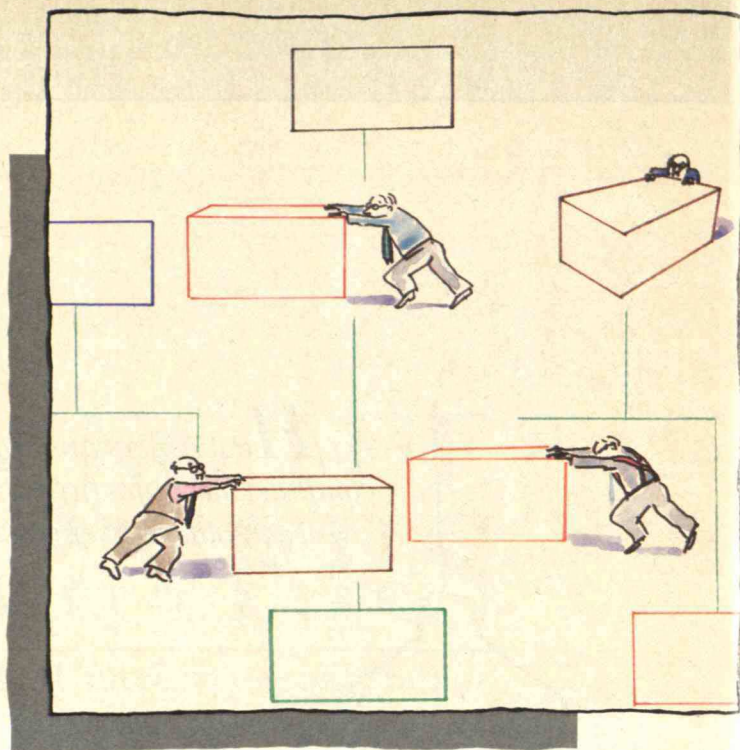
firms such as NEC and Fujitsu are developing similar facilities in the United States.

To make internationalization pay off and improve their ability to compete, however, firms need a clear understanding of the career expectations of research engineers, the incentive structures, and the organization of research in each country. Yet despite the voluminous literature on Japanese blue-collar workers and management styles, very little systematic research has been done on the careers and organization of Japanese engineers. So when the Harvard Program on U.S.-Japan Relations approached the M.I.T.-Japan Science and Technology Program to do a comparative study of R&D in the Japanese and U.S. computer industries, funded by Digital Equipment Corp., we leaped at the opportunity. Three leading U.S. computer firms (Digital, Data-General, and the Office Management Systems Division of Honeywell Information Systems) and three major Japanese computer firms (Toshiba, Fujitsu, and NEC) agreed to serve as research sites.

Careers Begin in the University

The college educations of engineers in the two countries differ markedly. Japan's college entrance examinations—the only criterion for admission—are extremely difficult. Students often spend a year or more after high school preparing full-time to take the exams. Each university gives its own exams, and students who fail those for the university of their choice have only three options: spend another year preparing for the tests, settle for enrolling at a less prestigious school, or enter the workforce and surrender all thought of gaining a higher education.

Gaining entrance to a good school is crucial since the status of the institutions Japanese engineers attend shapes their entire careers. This status determines engineers' opportunities for postgraduate education: most master's programs admit only graduates of their own bachelor's program. Also, major companies hire engineers directly out of universities



and rely heavily on the status of a school to judge the quality of an engineer.

Ironically, the quality of education seems to vary less among Japanese universities than among U.S. schools. However, the longstanding ranking of universities' prestige produces distinctions in the quality of their students. The greater a school's prestige, the higher the number and quality of the students who take the entrance exams. In this sense, the entrance exams and the universities perform a key "sorting function" for the large corporations.

Japanese undergraduates pursue a more general engineering curriculum than those in the United States, with few individual options. At the University of Tokyo, Japan's most prestigious engineering school, all engineering students take essentially the same courses. Virtually none take the specialized upper-level courses (such as central-processing-unit design) offered at leading U.S. institutions. These students have three hours of classes each weekday morning and an hour-and-a-half laboratory class on four afternoons. Grades are based almost exclusively on written final exams, which strongly emphasize general theory. Faculty supervise senior-year projects closely.

As a result, Japanese researcher managers say, it takes two years of on-the-job "apprenticeship" before a design engineer is capable of making an independent contribution to a research project. In contrast, the more specialized and applied training of the top U.S. institutions produces engineers who can quickly make important design contributions.

However, the homogeneous bachelor's prepara-

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*In Japanese firms,
design engineers follow their research projects
into manufacturing.*

tion, combined with the tendency of Japanese universities to admit only their own graduates to their master's program, make it possible for students to move quickly into intensive research on graduate projects. This research involves close interaction between students and faculty, with more emphasis on consultation to develop solutions to problems than in the United States. Japanese students at M.I.T. think that American students tend to bulldoze through to solutions by trial and error. The Japanese like to discuss problems with colleagues and instructors and to consider a variety of solutions before acting. This approach conserves equipment and resources and emphasizes problem solving over individual achievement.

Japanese universities also provide fewer technicians to aid postgraduate or even faculty projects. Japanese engineers and scientists therefore do more of the daily tasks that support R&D activities themselves. They acquire a more thorough sense of the nature and vulnerability of the equipment they use and the effort required to carry out their ideas.

The universities' emphasis on written examinations accustoms Japanese engineers to writing—a crucial channel by which Japanese researchers communicate with one another and with people in production. Japanese firms make greater use of formal seminars and meetings to disseminate research results at both the central labs and the divisions. The Japanese firms also encourage engineers, especially at the central labs, to give papers at conferences and to publish their findings. Companies apparently value the prestige that accrues from these activities and regard them as opportunities for researchers to build valuable networks. On the other hand, U.S. engineers communicate orally more frequently with engineers outside their own project team than do the Japanese.

From the University to the Corporation

Foreign companies and even smaller Japanese firms heavily criticize the Japanese system of corporate recruiting because it gives the major firms a virtual monopoly on the most promising graduates. Like all major Japanese firms, Toshiba, NEC, and Fujitsu recruit their engineers directly from universities. The students they take into their central labs, most with master's degrees, are hired based on a letter of recommendation written by a senior professor. That

professor will provide each of his students with *one* recommendation letter addressed to the firm that the professor deems most suitable. The student will virtually never try to find employment at another firm: no reputable company would hire someone without a letter. And the company will not reject an applicant from an elite university who has such a letter: to disregard a professor's recommendation would be to risk cutting off any possibility of recruiting his students in the future.

This system gives little choice to either student or employer. Students do have some influence over their professors' decisions, and the better the students the more likely the professors are to try to consider their wishes. This provides a powerful incentive for students to work hard and attract the favorable notice of their professors, especially in their senior year and in their master's project. This system provides clear benefits to the best students, who gain secure positions at leading firms with relatively little direct effort. Likewise, the leading firms benefit by receiving a steady supply of highly qualified graduates. Smaller, less prestigious firms and foreign subsidiaries attempting to break into the Japanese labor market have difficulties. Even offers of generous salaries, rapid promotion, and challenging work—the means by which smaller firms in the United States can outbid IBM or AT&T for the best engineering graduates—do not entice graduates away from the leading firms or persuade professors to send their best students to less secure employers.

The recruiting process helps tie Japanese engineers closely to a single employer throughout their careers. None of the three Japanese companies we studied tried to attract engineers away from other companies. Their attitude toward human resources seems to be "make, not buy." When Toshiba was developing the first Japanese-language word processor, for example, the project leader decided that he needed someone with training in linguistics to solve some software problems. Instead of hiring a linguist, he sent one of his own engineers to Kyoto University to study natural language systems for a year.

Moving People Instead of Ideas

Japanese and U.S. firms differ dramatically in the way they organize their R&D processes. These differences reflect contrasts in the origin and structure of the two computer industries.

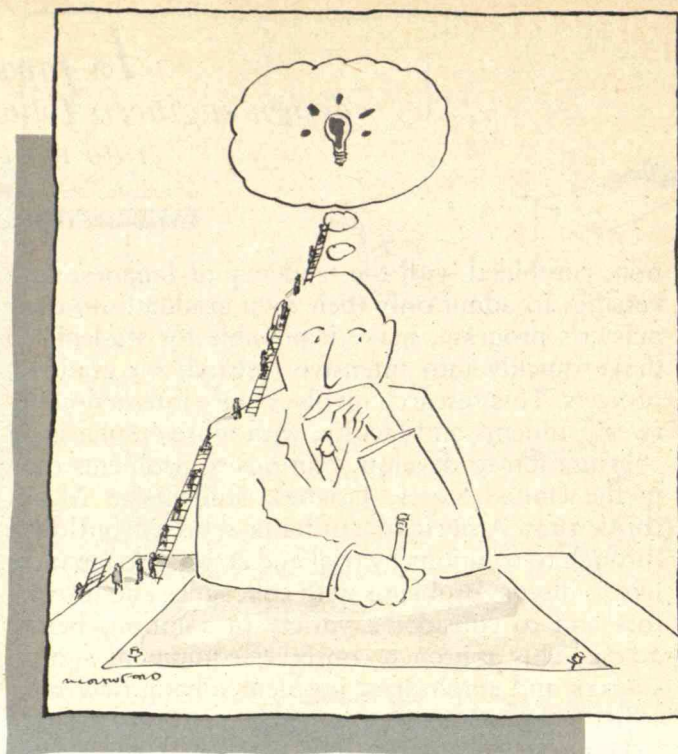
Most Japanese computer manufacturers make many kinds of electrical equipment. NEC, for example, produces not only computers, semiconductors, and telecommunications equipment but also a wide range of consumer electronics. These companies have adapted the R&D patterns established for other technologies to computer-related areas. In contrast, relatively young, specialized, entrepreneurial firms such as Digital and Data-General are much more important in the U.S. computer industry. Even an older and more diversified firm such as Honeywell fashions its Information Systems group on the patterns set by the newer companies.

NEC, Fujitsu, and Toshiba all have two levels of R&D facilities: corporate and divisional. Corporate-level facilities perform basic research and also take an R&D project to the stage of the first commercial prototype. They then pass the prototype along to a lab attached to one of the operating divisions, where engineers refine and test it for manufacturing. The divisional labs are closely integrated with manufacturing in both physical location and communication.

At first glance, R&D at the three U.S. firms seems analogous to the Japanese system. All three have design and development groups organized by products or components (such as disk drives, memories, or software), and all three have so-called advanced technology groups working on new technologies and applications. However, the latter groups are much smaller than the Japanese central labs, and they specialize more in the earliest stages of R&D. Thus, they play a much less crucial role in developing products.

Even more important, the U.S. firms do not maintain the close link between design groups and manufacturing that the Japanese do. In Japan, this tie begins with the corporate R&D budget, which is divided between the central lab and the operating divisions. The divisions can use their funds either to enhance products they have developed or to commission research from the central lab on new products or major product changes.

The handoff of research from one level to another is perhaps the single most dramatic difference between the Japanese and U.S. firms. All three U.S. companies pass projects from design to manufacturing primarily by assigning one manager to be responsible for the transfer. He or she is usually responsible for several projects at once, is a permanent member of the design staff, and is seldom involved in "hands-on" work on a particular project.



The Japanese, on the other hand, move technology from design into manufacturing by transferring a member of the corporate design team into the divisional lab, where that person has the major responsibility for carrying the project through. Most engineers welcome this transfer, which usually occurs after six to eight years, as their first major promotion and it comes with a significant salary increase and a raise in rank.

Research managers at all three Japanese companies stress that the constant flow of people from the center lab to the divisions is the key factor in smoothly transferring technology within a firm. This flow also eliminates the problem of early "over-specification" that plagues U.S. firms. In the Japanese firms, specifications need not be finalized until the product reaches the divisions. Japanese think the U.S. practice of working out extremely detailed—and perhaps rigid—specifications at the R&D level results from a lack of trust in manufacturing people. Since factory managers in Japan are themselves engineers, some with active design experience at the central or divisional labs, researchers are less likely to view them as incapable of understanding complex design issues.

Japanese engineers work in the divisional labs for four to five years and then typically move into line management in the manufacturing division. Not all engineers take this path, of course. A small number remain either in the central lab or the divisional lab, and from these engineers the company draws its research managers. Individual engineers have little

*American engineers
should spend more time on design work, which
they enjoy most and probably do best.*

choice in which path to take; they go where the company sends them, and the company sends the overwhelming majority of design engineers into line management within ten to twelve years. This is a major contrast with American companies, where the managerial rungs of the "dual career ladder" lead not into line management but into research management.

Clearly the Japanese model of linking internal technology transfer with engineers' careers differs sharply from the system in U.S. firms. In the three American companies, the locus of responsibility for designing a career lies with the individual engineer. In Japan, it rests with the company. The result is that in Japan, engineering careers, like education, are much more standardized.

Rewards, Incentives, and Mid-Career Training

The greater standardization of careers and company control over Japanese engineers is reflected in their rewards and training programs. All Japanese engineers receive essentially the same entry-level salaries, which are identical to those of managerial recruits. All engineers also receive the same annual raises. Outstanding performers are rewarded with the recognition of colleagues and superiors, more challenging assignments, and the prospect of rising higher in the company in the long run. (However, Japanese engineers do believe that graduates of the elite universities have a better chance of being defined as outstanding performers, and that graduates of less prestigious institutions are likely to be seen as less able and given fewer chances to prove themselves.)

Japanese engineers therefore find it relatively easy to describe a typical career with typical wages. U.S. engineers find such an idea almost comic. Salaries and salary increases vary greatly within U.S. firms, and engineers see their chance of getting a job outside the company as a major lever for winning salary increases from their current employers. They see raises as *the* major reward for outstanding contributions and consider the symbolic value of such raises as important as the money itself.

The greater company control of careers in Japan also influences the training patterns within a company. Since recruiting takes place once a year, new employees arrive as a group and can go through an introductory training program en masse. This intense initiation, which includes both technical and

managerial recruits, exposes new employees to a firm's range of activities and establishes a personal basis for communication among the employees after they disperse to their new positions.

Japanese and U.S. engineers take about the same number of technical courses after they join a company. However, American engineers take courses mostly to improve their career opportunities, while Japanese engineers are more likely to be assigned to courses by their supervisors. Japanese firms also rely more heavily on "in-house" programs for mid-career training. Each company has its own training centers and experts. NEC's central training institute, for example, is one of the country's largest, and provides master's level programs in electrical engineering for employees.

This reliance on in-house resources has its critics in Japan, who identify several drawbacks: it fails to expose engineers to a wide variety of approaches to problems; it shuts the engineers at smaller companies out of the country's major continuing-education programs; and it means that the company rather than the individual decides who receives mid-career training and when he or she receives it. Of course, the last two problems are also key advantages for the corporation that can afford extensive in-house training for its employees.

However, exceptions to the tendency of major Japanese employers to provide in-house training for their employees are growing. Japan's newest university, Tsukuba, encourages companies to dispatch engineers to its campus for continuing education. The Japan Union of Scientists and Engineers runs courses on quality control that attract people from all the major companies. And Toshiba, NEC, and Fujitsu all send a small number of engineers abroad—usually to the United States—for advanced study. These companies use such opportunities as rewards and incentives for especially promising engineers. Thus, many key Japanese researchers get firsthand exposure to U.S. research. M.I.T., for example, hosts more than a hundred Japanese engineers either working for advanced degrees or spending a year visiting with a Japanese-funded research project. Although a handful of U.S. programs provide opportunities for American science and engineering students to spend time in Japanese labs, the trans-Pacific flow of U.S. engineers is a tiny fraction of the Japanese effort, and therefore there is no comparable U.S. exposure to Japanese experience.

*Many Japanese researchers
get firsthand exposure to U.S. research, but there is
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U.S. engineers.*

Life-Long Careers

Corporate control of careers, standard salaries, in-house training programs, and study abroad are all components of the long-term orientation of Japanese personnel planning. This orientation is reciprocal: employees know that they probably will be part of the company until they retire, and the company knows it cannot readily go outside its own ranks to obtain specialized, skilled engineers.

The ability of an engineer to change assignments within a company derives from this long-term orientation. In all three U.S. companies, engineers feel that if they develop a high level of skill in one subject area, they will have to remain in that role on many projects. U.S. employees must show considerable initiative and aggressiveness—or change employers—to get “out of the rut.” The Japanese build job rotation into the career path of every engineer who enters the central research labs: a supervisor there might lament the transfer of skilled young engineers to a new activity but would not have the power to keep them back. This system has the advantage of producing engineers who, by the time they carry a research project forward into production, understand most aspects of the technology.

Perhaps the most important result of this long-

term orientation is the slower pace of evaluation. Japanese engineers are judged in terms of their potential, measured during several years of work, as much as their current performance.

In both countries, an engineer's supervisor plays the key role in the evaluation process. However, while U.S. American firms emphasize face-to-face feedback sessions between supervisors and engineers, Japanese engineers do not have access to their annual evaluations. (They do fill out an annual self-report.) This system undoubtedly causes greater uncertainty among employees, especially since salary and promotion rates vary so little.

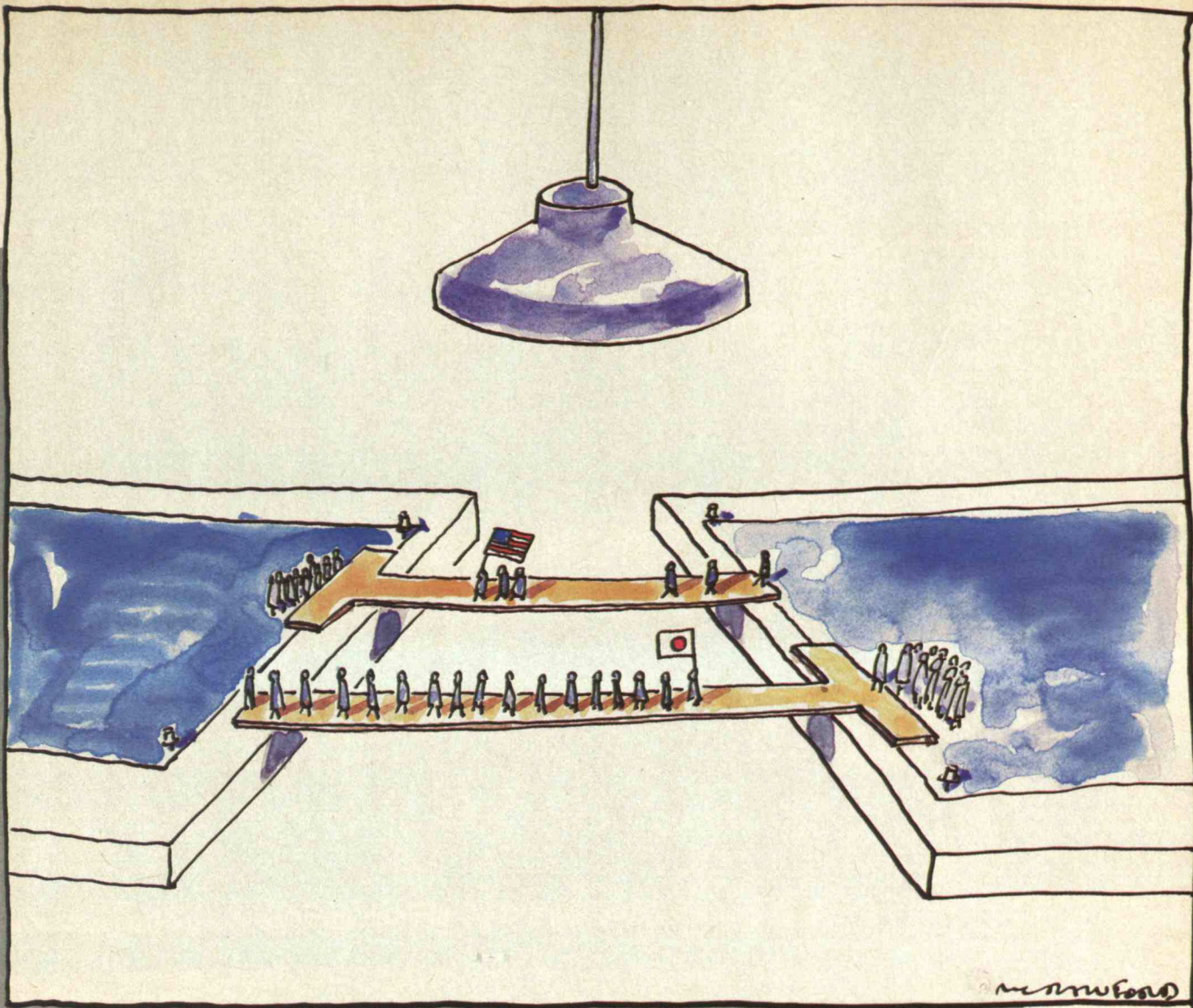
This uncertainty, coupled with the fact that Japanese engineers must prove themselves over a longer period of time, may provide an answer to a question Americans frequently ask: “Do the Japanese really work harder?” Among the engineers we looked at, the answer appears to be “yes.” Japanese engineers at the central labs said they work, on the average, 49 hours a week; the average rose to 53 hours among the divisional engineers. U.S. engineers said they work an average of 44 hours a week.

Moreover, American engineers' individual hours vary more than those of the Japanese. The hardest-working American puts in longer hours than the hardest-working Japanese, but U.S. engineers at the lower end of the spectrum put in fewer hours than their Japanese counterparts. One reason may be that U.S. engineers learn relatively quickly whether they will be stars or simply good but not outstanding engineers. They may therefore cease to push themselves at an earlier age.

U.S. engineers also say they peak at an earlier age than do the Japanese (*see the chart at left*), especially in the area of management. This reflects the fact that the Japanese assume managerial responsibilities later in their careers, and that responsibility for evaluating others carries a much higher rank than in the United States. An American engineer with as few as two or three subordinates may be responsible for submitting evaluations of those employees. Japanese engineers do not evaluate others until they become section heads, with from 10 to 20 subordinates. This system frees younger engineers from personnel matters and makes standardized evaluations easier because relatively few people conduct them. It also allows Japanese researchers to spend more of their time being productive as engineers. Engineers at the central labs spend an average of 53

COMPARISON OF ENGINEERS' VIEWS ON AGE AND CAREER

At roughly what age does an engineer...	Japan (Central)	Japan (Division)	U.S.
Put the greatest effort into work?	31.86	30.61	28.06
Perform the most tech- nically sophisticated work?	33.50	31.82	32.60
Begin to face problems of “technical obsolescence”?	42.24	42.40	38.76
Perform best as a manager?	46.83	40.41	38.99



percent of their time directly on R&D; U.S. engineers spend 39 percent.

The factors companies consider when promoting an engineer to project leader reflect the two societies' different conceptions of the role. American firms expect the project director to be a technical expert able to make key decisions about technical problems. Japanese firms expect the project leader to be a manager of researchers. Hence U.S. engineers see technical expertise as the key factor in promotion to project leader. At Japanese central labs, a track record of participation in successful projects, seniority, and administrative ability are much more important than technical expertise. In the divisional labs, administrative ability counts highest, followed by seniority and technical expertise. U.S. firms consider administrative ability and seniority almost irrelevant.

The two societies differ less when it comes to putting a project team together. In both the United

States and Japan, managers want engineers interested in the research and a team that has both depth and variety of technical knowledge. However, the Japanese weigh heavily the likely harmony of personalities and the balance of ages within the group.

The Innovation Process: New Projects

New projects at the Japanese corporate labs arise in two ways. The divisions, closely allied with the production end of the company, commission a number of projects, and the rest originate within the corporate labs. Fairly extensive study often precedes the formal approval of projects generated within the central labs. This "pre-project study" (the closest thing to the "bootlegging," or unauthorized research, that is common in U.S. firms) is a major source of new projects. American companies, fearing that engineers
(Continued on page 68)





High-Speed Rail

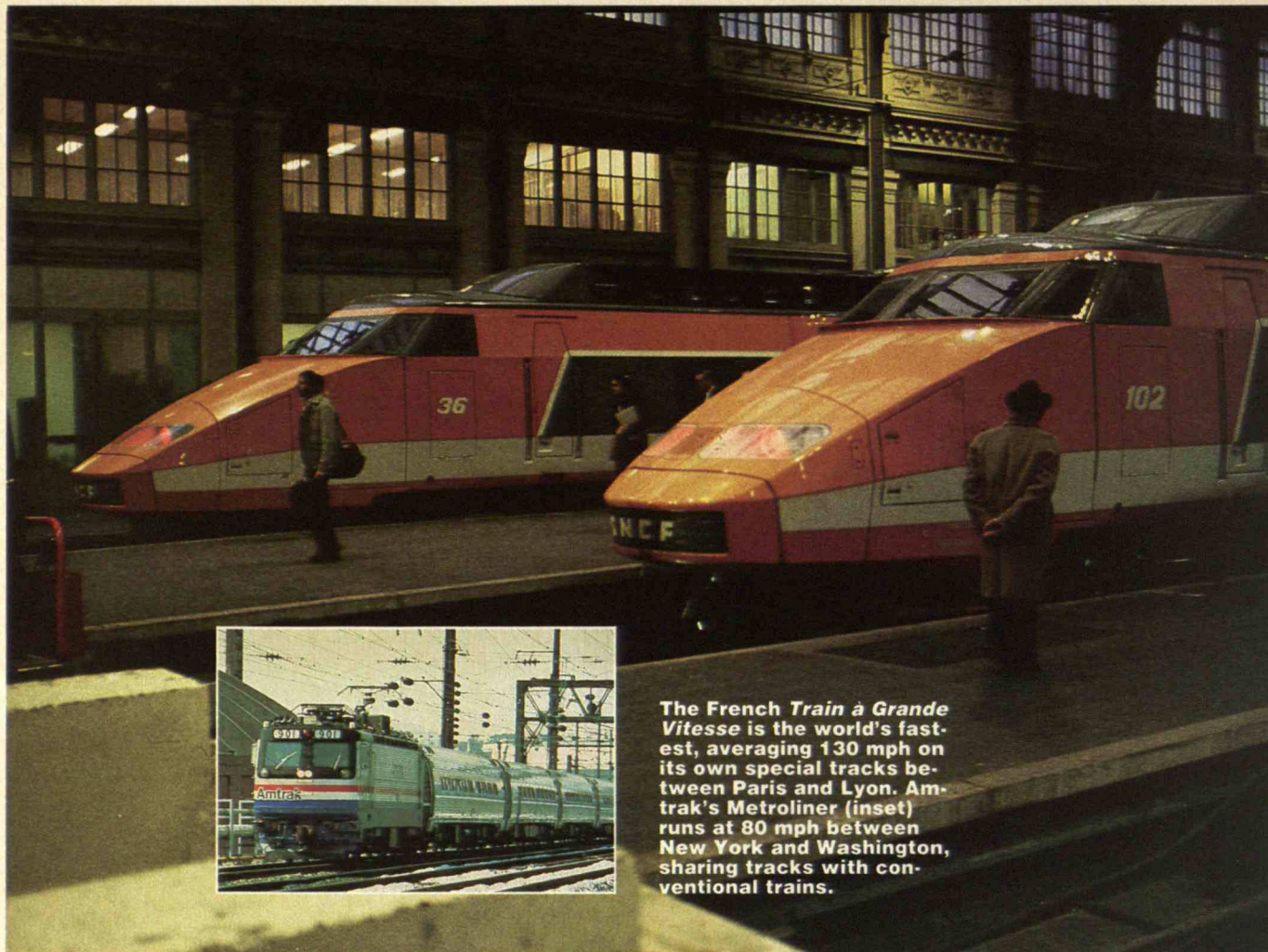
*The technology is waiting,
the vision seductive.
But balancing costs and benefits,
tangible and intangible,
is controversial.*

BY LOUIS S. THOMPSON

Is there a future for high-speed intercity rail transportation in the United States?

Skeptics abound, calling attention to the plight of Amtrak and other conventional rail passenger services, which exist in the United States only where heavily subsidized. But within the past 5 to 10 years our country has seen a dramatic resurgence of interest in building high-speed rail systems, on which trains operate at 120 miles per hour or more over significant sections of their routes.

Since entering service in 1964, Japan's first electric-powered *Shinkansen*, which averages slightly better than 100 mph over its 600-mile route between Tokyo, Osaka, and Hakata, has completed more than 2 billion passenger trips without a single fatality—proving that high-speed rail is not only technically feasible and safe but also marketable, at least when the population density and the demand are high. The British High-Speed Train has shown that diesel-powered equipment can operate on tracks also used for conventional service. Finally, the French



The French Train à Grande Vitesse is the world's fastest, averaging 130 mph on its own special tracks between Paris and Lyon. Amtrak's Metroliner (inset) runs at 80 mph between New York and Washington, sharing tracks with conventional trains.

Train à Grande Vitesse (TGV), which averages 130 mph between Paris and Lyon, has successfully tested two engineering innovations: unprecedented steep gradients and speeds of up to 170 mph—nearly 40 percent faster than any previous train.

The United States entered the high-speed rail sweepstakes in 1976 by upgrading the Metroliner in the Northeast Corridor between Washington and Boston. The fastest service now operates at 120 mph over about half of the distance between Washington and New York, and the top speed will rise to 125 mph within about a year as improvements are completed. Because of station stops and some unavoidable speed restrictions, the average Washington-to-New York speed is just under 80 mph. (This compares with an average of just over 50 mph between

New York and Boston, where diesel power and circuitous track, much of it shared with heavy commuter service, reduce speed.)

As train speeds have increased between Washington and New York, patronage has slowly improved—even from a base inflated by a gasoline shortage and despite airline deregulation that has encouraged vigorous competition in price and service. This success, together with that elsewhere in the world—indeed, there is no example of a failed high-speed rail service—has resulted in several proposals for new U.S. routes from groups of potential high-speed rail investors, suppliers, and operators that are listed in the chart on page 40. And the likely roles of various parts of the public sector are becoming more clearly defined.

The Key Variables in Planning

Unfortunately, something about a high-speed railroad leads people to focus on the parts instead of the whole. One reason is that users see only the stations and the equipment; they do not appreciate the extent or cost of the civil engineering facilities—

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Top: For trains that are already moving fast, increases in speed yield smaller and smaller reductions in travel time. This is not an argument against high-speed rail. Rather, it is an argument for high-speed lines with few intermediate stops.

Bottom: The amount of centrifugal force that passengers can tolerate limits the sharpness of curves that can be built into any rail line. And as the speed for which a line is designed increases, this limitation becomes markedly more severe.

the roadbed, track, and bridges. Another reason is that many people, taken up with the romance of railroading, see a modern railroad in the image of the past.

In reality, a modern high-speed railroad is a carefully designed, highly integrated system of many complex components. Hard experience has taught us that components from old systems can seldom be used efficiently with new systems. The Northeast Corridor track—the only one in the United States that meets Federal Railroad Administration (FRA) standards for operation at over 110 mph—incorporates 500 tons of new rail and more than 1,000 tons of new concrete ties per mile. The rolling stock and signalling system are also highly specialized. Between Washington and New Haven, trains are pulled by the only high-speed electric traction system in the country. The signal system includes both wayside and in-cab speed indications and permits bidirectional operations on most main tracks. Stations are carefully planned to be efficient and accessible. And the track and trains require modern, specialized equipment and facilities for proper maintenance.

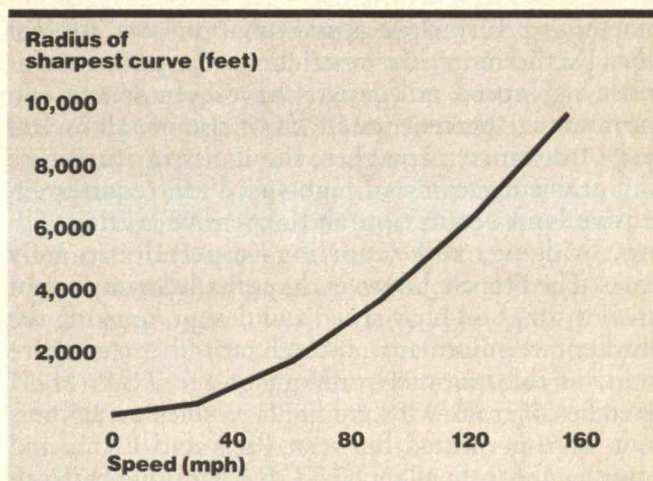
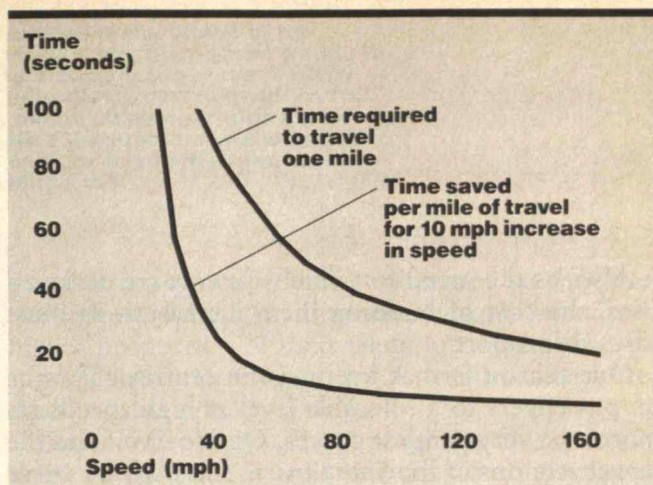
Two decisions are basic determinants of the capital cost of any projected high-speed rail system:

- ☐ Is the railroad to be a new facility or is it to be a rehabilitated existing facility?
- ☐ Is the railroad to be a dedicated (single-purpose) facility, or will it carry different kinds of traffic, such as commuter, freight, and high-speed intercity?

Most of the high-speed rail proposals now attracting attention in the United States assume construction of a brand new, dedicated facility. In this respect they resemble the Japanese *Shinkansen*, which runs on special tracks and shares only station facilities with conventional rail services. While this is the most exciting engineering challenge, it is by no means the only alternative. At the other end of the scale, British high-speed trains, like those in the U.S. Northeast Corridor, travel on rehabilitated right-of-way shared with other rail service. The French TGV system may have the best of both approaches. One of its major innovations is the adroit use of the existing right-of-way to enter and leave urban centers; new right-of-way was built only in the rural areas.

Surprising Economics

The question to ask first about every high-speed rail proposal is this: What does its speed really cost us?



The answers are often surprising. The time saved by increasing the speed of a train is very much subject to the law of diminishing returns. As the speed increases, the time required to travel a given distance decreases by smaller and smaller amounts. It works this way: At any particular speed S (in miles per hour), the time in seconds required to traverse one mile is given by the expression $(3600/S)$. Thus, for example, it takes 60 seconds—or $3600/60$ —for a train to travel one mile at 60 mph. If the speed of the train is increased by a 60-mph increment to 120 mph, the time to travel one mile is $3600/120$, or 30 seconds, and the time savings is 30 seconds. On the other hand, when the speed of the train is increased another 30 mph, to 150 mph, the time to travel one mile is $3600/150$, or 24 seconds, which means a time savings of only 6 seconds.

The lesson is not necessarily that high speed is undesirable. It is, instead, that the advantage of high speed depends upon going long distances without stopping and upon avoiding low speed for any distance. This is why the promising opportunities for high-speed rail are on routes at least 200 miles long with only a few intermediate stops.

Also, as the speed for which systems are designed rises, the cost of building them increases—in most cases disproportionately.

One reason is that keeping the centrifugal force on passengers to a tolerable level at high speeds requires the very gentlest curves. On the *TGV* and the newer sections of the *Shinkansen*, the sharpest curve permitted for trains operating at up to 170 mph is an arc of a circle whose diameter is about eight kilometers—a very close approximation of a straight line. Furthermore, the restrictions on gradients for most high-speed rail designs have been severe—no more than 1 percent (one foot of rise or fall in 100 feet of distance). Together, the limits on curvature and gradient mean that high-speed rail requires extensive land acquisition and expensive cutting, filling, bridging, and tunneling—especially in hilly areas. The French, however, have made an important breakthrough in high-speed rail design, relaxing the gradient requirement, though not the curvature limit, in the innovative design of the *TGV*. Short stretches of track with gradients as steep as 3.5 percent were permitted between Paris and Lyon, and equipment for the planned *TGV Atlantique* between Paris and Bordeaux will be designed for grades up to 5 percent. Such gradients are made possible by electric propulsion with somewhat more horsepower than is conventional, and a willingness to let the train alter its speed as it travels up and down grades.

The requirements on track precision are dramatically greater for high-speed rail, too. Slow-moving freight trains and conventional commuter service can be operated with relatively large discrepancies between the level of one rail and another. FRA standards permit a maximum discrepancy of 1.25 inches for 80-mph operation. But the French require discrepancies of no more than 0.16 inches for the 170-mph speeds of the *TGV*, and the FRA standard for 120 mph is 0.5 inches. There is nothing impossible about such requirements. Satisfying them is, however, very expensive.

Several different high-speed propulsion systems have now been tested, and the economic trade-offs between them are therefore well known. The initial cost of diesel power, such as used by the British high-speed train, is lower than that of electric propulsion: no overhead wiring or wayside transformers are needed. But the engine is mechanically more complex, uses more energy (which can be obtained only from liquid fuel), and offers much lower accelera-



tion, especially at high speeds. Electric propulsion, on the other hand, is quieter and non-polluting, and the power can be efficiently obtained from many different fuels. When several units throughout a train are electric powered, as they are on the *Shinkansen*, high initial cost due to complexity is offset by the greater reliability that comes with redundancy and better traction. However, with either kind of equipment, the trains themselves represent, at most, only about 20 percent of the capital cost of a high-speed rail system.

More exotic technology may be available in the future, in the form of two schemes for magnetic levitation that are now in the development stage. Japanese National Railways (JNR) is studying a system with on-board superconducting magnets that, acting together with passive coils embedded in a guideway, lift, guide, and propel a train. German engineers are working on a system that would suspend the train between attracting magnets in train and guideway and use feedback to maintain the train's position. Both systems would require a specialized guideway, but they would make possible speeds of 200 to 250 mph or more—faster than is



Japan's Tokyo-to-Osaka *Shinkansen* is the oldest of the world's few high-speed trains. It is also by far the most heavily patronized, carrying 125 to 150 million passenger-trips a year. No comparable demand is forecast for any high-speed route in the U.S.

likely with our present steel-wheel-on-steel-rail technology. Moreover, since there would be no physical contact between train and guideway, maintenance and operating costs might be lower.

The Japanese have been testing their magnetic levitation system for over eight years, and all of the problems identified so far appear solvable. The Germans are also optimistic, though they have only begun the testing cycle. But neither system is likely to be ready for another two to five years. Only then will the new technology face the weather, maintenance, and service problems that tests somehow never adequately simulate.

Predicting Operating Cost—the Easy Part

The higher capital cost of conventional high-speed rail is accompanied by higher operating cost. Because the track geometry must be so precise, track maintenance for high-speed rail is expensive. And because the forces that the equipment exerts on the track increase exponentially with speed, maintenance cost is extremely sensitive to the speed at which the system is operated. Modest reduction in costs may be

possible if new trains can be designed so that they are lighter, have less unsprung weight—that is, a higher proportion of their weight carried above the springs—and have their total weight distributed equally among many wheels.

Another problem is that at high speeds (over 100 mph) energy use per mile increases with the square of the speed. In other words, boosting speed from 90 to 125 mph could double fuel consumption. But designs involving less weight and air resistance can improve fuel economy. For example, at 170 mph the TGV uses only as much energy as Amtrak's Metroliner at 120 mph. And though energy is always a significant expense (20 to 30 percent of total operating cost), every high-speed rail system has a substantial efficiency advantage over its principal competition: Metroliner and *Shinkansen* can carry a given number of passengers for about one-sixth as much energy per mile as a narrow-body aircraft.

There are other cost advantages of high-speed rail. The French have demonstrated very impressive crew productivity on the TGV, where some trains are operated with three-person crews—one-half to one-third the complement on other high-speed systems. Furthermore, ticketing for high-speed rail is simple and easily automated: there are likely to be few stops and few auxiliary services such as parlor or sleeping cars.

Revenue—Hard to Forecast

Our ability to forecast the demand for high-speed rail service, and therefore the income that it may generate, is far poorer than our ability to forecast capital and operating cost. Indeed, some demand factors are unknowable before service actually begins.

Forecasting traffic has been easier overseas than in the United States. In both Japan and France, the existing rail capacity was saturated when high-speed rail was inaugurated. The main question was how much of that traffic the *Shinkansen* and the TGV should accommodate. By comparison, the Metroliner presented several difficult forecasting problems. One of these was how to predict demand for an improved service that had never been fully utilized in its unimproved state. Another was how to calculate the effect of competing carriers. For example, the 1971 forecasts of the office of the Secretary of Transportation and even the 1977 and 1978 FRA

Top: The faster trains are to travel on a track, the smaller must be any discrepancies between the heights of the two rails.

Bottom: High-speed operation puts a great deal of stress on the precision-engineered track. As a result, maintenance is costly.

forecasts could not have taken into account the competition created by lower air fares resulting from airline deregulation.

A third issue lies in assessing the extent to which a new travel mode may increase the total travel along a route. An exciting new form of transportation indisputably produces some new travelers. But only heroic investors will put up money on the basis of such induced demand.

Building on Foreign Experience

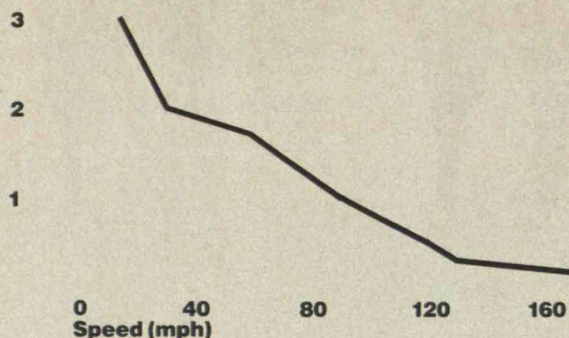
Many analysts have tried to compare the economic performance of high-speed rail in the United States with that overseas. Their results are at best imprecise because conditions vary between projects in ways that are hard to evaluate. Converting foreign currencies into the dollars of many different years is also difficult. Yet some general conclusions are possible, and foreign experience is particularly helpful in judging indirect benefits and costs.

All available evidence suggests skepticism about any proposals for new systems with capital costs of less than \$10 to \$20 million per mile. The Japanese report spending \$30 to \$40 million per mile between 1975 and 1982 to build the new *Shinkansen* systems north of Tokyo. Merely rehabilitating the Washington-New York segment of the Northeast Corridor cost about \$5 million a mile. And while the French claim a cost of only \$4 million per mile for the *TGV*, they benefited from using existing stations, urban track, and maintenance facilities that would normally not be available to builders of new systems in the United States.

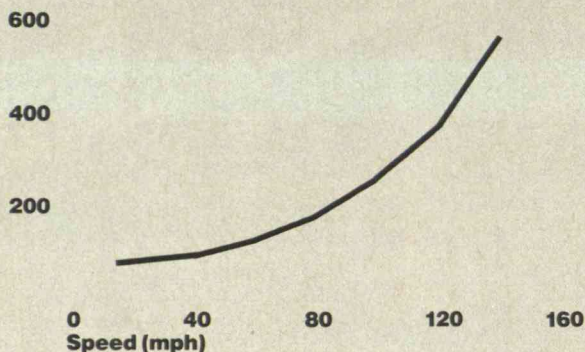
Another fact is clear from these comparisons: construction cost per mile goes down very little as the length of a high-speed rail line increases.

On the other hand, there are major economies of scale in operations. Costs per passenger mile appear to decrease sharply as the number of passengers increases. This works to the advantage of the *Shinkansen*, where annual ridership on the highly profitable Tokyo-Hakata line is a prodigious 125 to 150 million passenger trips. The *TGV* between Paris and Lyon serves 16 million passenger trips a year. However, in the New York to Washington segment of the Northeast Corridor—where ridership is probably the most intensive of any route in the United States—the total is only about 8 million passenger trips a year. Clearly, we should be very skeptical of

Maximum permissible height discrepancy between rails (inches)



Relative track maintenance cost (60 mph = 100)



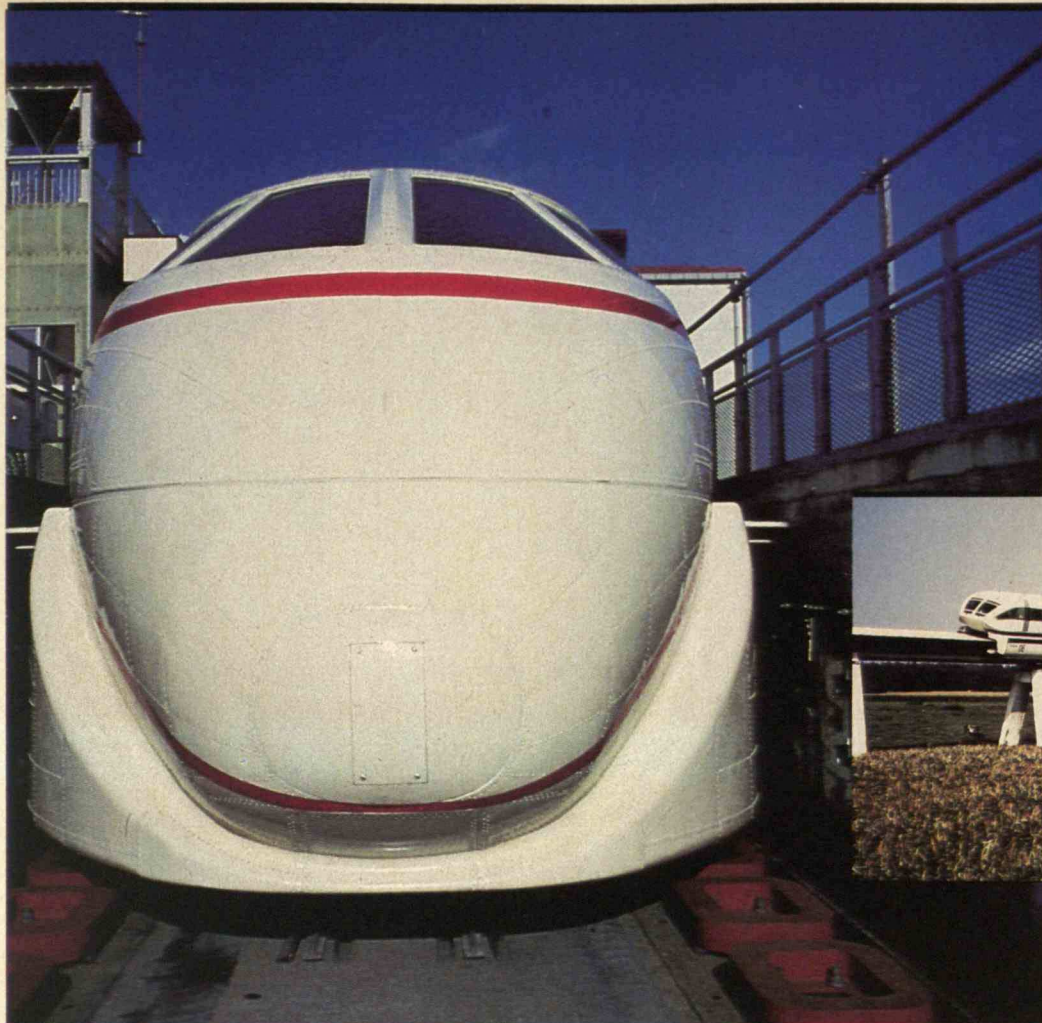
estimates that equate the demand for high-speed rail in the United States with that in Europe and Japan.

On the basis of revenue generated per dollar of investment—the primary determinant of an investment's ability to earn an adequate return—the *Shinkansen* line linking Tokyo, Kyoto, and Hakata and the *TGV* between Paris and Lyon stand far above other existing high-speed rail systems. Both earn about 20 cents in revenue per dollar of investment. Nothing else is even close, except the promoters' projections for the proposed Los Angeles-San Diego line. Significantly, this level of earnings may be the minimum a high-speed system needs to operate without some way of directly capturing the value of indirect benefits.

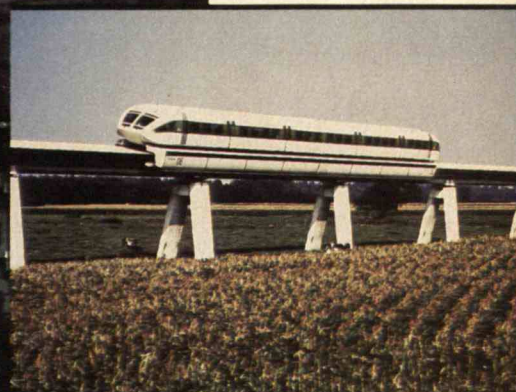
The Lure of Indirect Benefits

In addition to tangible revenues, promoters often cite indirect benefits that may offset the costs of high-speed rail. These include making travel safer and more reliable, reducing environmental impacts, stimulating economic development, and creating jobs.

High-speed rail systems have uniformly better pas-



Trains that use magnetic levitation to lift themselves off special guideways are now being tested in Japan and Germany (inset). But the 200-to-250-mph service that the sponsors of such trains promise will not be commercially available for at least a decade.



senger safety records than air or, especially, automobile transport. It is not clear, however, whether travelers' decisions between competing forms of transportation are affected by this safety record.

All-weather reliability is another noteworthy advantage of high-speed rail. With proper signalling and control systems, railroad operations can run efficiently despite all but the most severe weather conditions. During much of the day, JNR operates ten 16-car *Shinkansen* trains per hour in each direction between Tokyo and Osaka, and an astonishing 95 percent of them are on time.

Experience in Japan and France shows that on a per-passenger basis high-speed rail affects the environment much less than competing modes of travel. Though railroad noise has brought complaints in urban areas, most people acknowledge that high-speed rail pollutes the air less than do automobiles and causes less visual intrusion. In Florida, environmentalists advocate high-speed rail service between the major centers of Tampa, Orlando, and Miami as a tool to guide future development away from ecologically fragile coastal areas.

Rail systems stimulate intensive economic devel-

opment around stations, and thus can help revitalize the centers of cities in which the stations are situated. The *Shinkansen* has already done so in Japan, as almost any traveler can testify, but we in the United States have been comparatively slow to realize the economic potential of railroad stations. We are catching up, however. Recent visitors to Providence, Wilmington, New Haven, Newark, or Baltimore can testify to the role that the rail station is expected to play in these urban centers.

Supporters of Amtrak and the TGV have argued that efficient, low-cost passenger service assures mobility to people who otherwise could not travel. My experience on the *Shinkansen* indicates that all income levels do make intensive use of the train. Thus wider distribution of travel opportunities may indeed be an intangible benefit of high-speed rail. On the other hand, the proposition that construction and operation of a high-speed rail system will create new jobs deserves careful examination: some other project might create just as many.

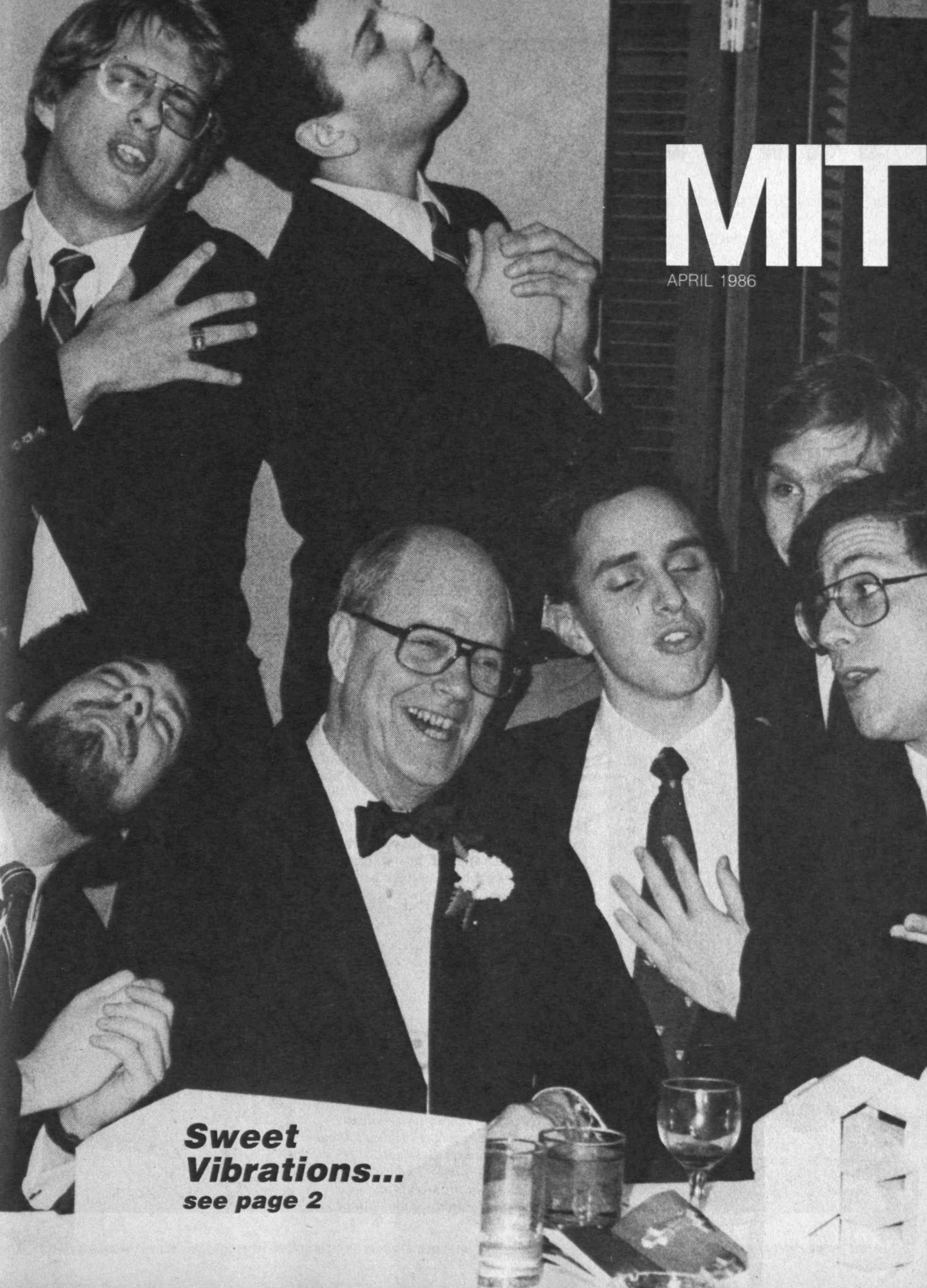
Finally, high-speed rail systems are often advocated for their "image" value. Promoters in both Florida and Las Vegas have argued that high-speed



The Japanese National Railroads' Shinkansen between Tokyo and Hakata carries far more passengers than any other high-speed train in the world. Only it and the French Train à Grande Vitesse (TGV) are generating enough income to operate without subsidy. Most other existing and proposed high-speed lines can be operated profitably only if a high value is assigned to such indirect benefits as cleaner air, lessened environmental impact, safer and more reliable transportation, and greater midtown prosperity.

			Miles of line	Average end-to-end speed (mph)	Total investment (billions of 1985 dollars)	Investment per mile (millions of 1985 dollars)	Annual passenger-miles (millions)	Operating cost (cents per passenger-mile)	Revenue per dollar invested (cents)
OPERATING HIGH-SPEED SYSTEMS									
Japanese National Railways Shinkansen									
Tokyo-Osaka-Hakata	Electric power, dedicated track		668	100	\$18.3	\$27.5	26,155	7.5c	19.4c
Tokyo-Morioka	Electric power, dedicated track		290	94	10.7	36.7	3,713	6.3	5.3
Tokyo-Niigata	Electric power, dedicated track		169	97	5.3	39.0	1,404	9.1	4.4
French National Railways TGV									
Paris-Lyon	Electric power, dedicated and shared track		265	130	1.7	6.8	4,900	2.7	20.3
Amtrak (U.S.) Metroliner									
Boston-Washington	Electric and diesel power, shared track		456	80* 56#	2.8	6.2	1,207	12.8	7.2
PROPOSED U.S. HIGH-SPEED SYSTEMS									
New York-Vermont-Quebec									
New York-Montreal	Electric power, dedicated and shared track		362	116	2.4	6.7	466	11.8	3.5
Ohio									
Cleveland-Columbus-Cincinnati	Electric power, dedicated track		330	100	2.1	6.3	670	6.8	7.2
Florida									
Tampa-Orlando-Miami HSR	Electric power, dedicated track		314	123	2.8	8.8	415	15.0	3.2
Tampa-Orlando-Miami MAGLEV	Electric power, dedicated guideway		314	196	5.0	15.9	465	17.5	2.0
Pennsylvania									
Philadelphia-Pittsburgh HSR	Electric power, dedicated track		314	96	9.3	29.6	985	13.5	1.7
Philadelphia-Pittsburgh MAGLEV	Electric power, dedicated guideway		314	120	13.0	41.3	1,216	14.6	1.6
California									
Los Angeles-San Diego HSR	Electric power, dedicated track		132	127	3.0	25.3	1,793	5.4	15.4
Illinois-Michigan									
Chicago-Detroit HSR	Diesel power, shared track		280	79	0.7	2.6	498	9.0	10.5
Chicago-Detroit HSR	Electric power, dedicated track		280	104	1.8	6.4	607	7.7	5.5
Chicago-Detroit MAGLEV	Electric power, dedicated guideway		280	166	2.9	10.3	881	10.6	5.2

*Washington-New York
New York-Boston



MIT

APRIL 1986

**Sweet
Vibrations...**
see page 2

TRIBUTE TO ASTRONAUT RONALD MCNAIR, PH.D. '76	6
STREHLE NAMED V.P. FOR DEVELOPMENT	4
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April 1986 is the first edition of *Technology Review* that combines the former "A" and "B" pages into one MIT section, providing class notes to all alumni subscribers. This move gives us more flexibility in allocating pages, and enables graduate alumni to read about the achievements of their undergraduate friends. Enjoy.



ABOUT THE COVER

The Logarithms offer some not-so-random vibrations to toast the 65th birthday of Professor Stephen H. Crandall, Ph.D. '46, the world expert in random mechanical vibration, in a tribute arranged by Crandall's colleagues and former students. (Photo: Frank Revi '86)

M.I.T.'s Night in New York, with Pizzazz

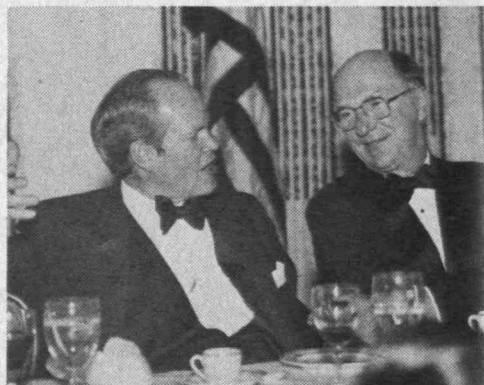
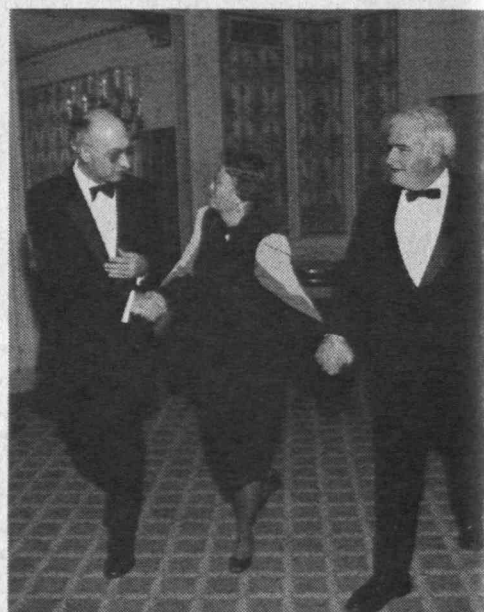
Whole weeks go by when we have no occasions like this," quipped Paul E. Gray, '54, as he surveyed the glittering scene at the Pierre Hotel on February 18. Black ties, sequined gowns, exotic centerpieces at each table reflecting dramatic, theater-type lighting, and a seating chart that read like a directory of who's who in the New York business community.

There were even video productions featuring M.I.T. achievements shown between the poached salmon and filet mignon, and chocolate beavers served with the coffee.

The \$350-a-plate Gala Dinner Dance sponsored by the M.I.T. Alumni Center of New York was a fund-raiser for the Institute, according to the chairman of the event, John K. Castle, '63, chairman and CEO of Donaldson, Lufkin & Jenrette. There were more than 50 corporate sponsors, and many would-be ticket buyers had to be turned away from the sell-out event.

But most importantly, Castle said, the gala was a chance for alumni to have a good time while heightening the profile of the Institute among graduates and non-grads alike.

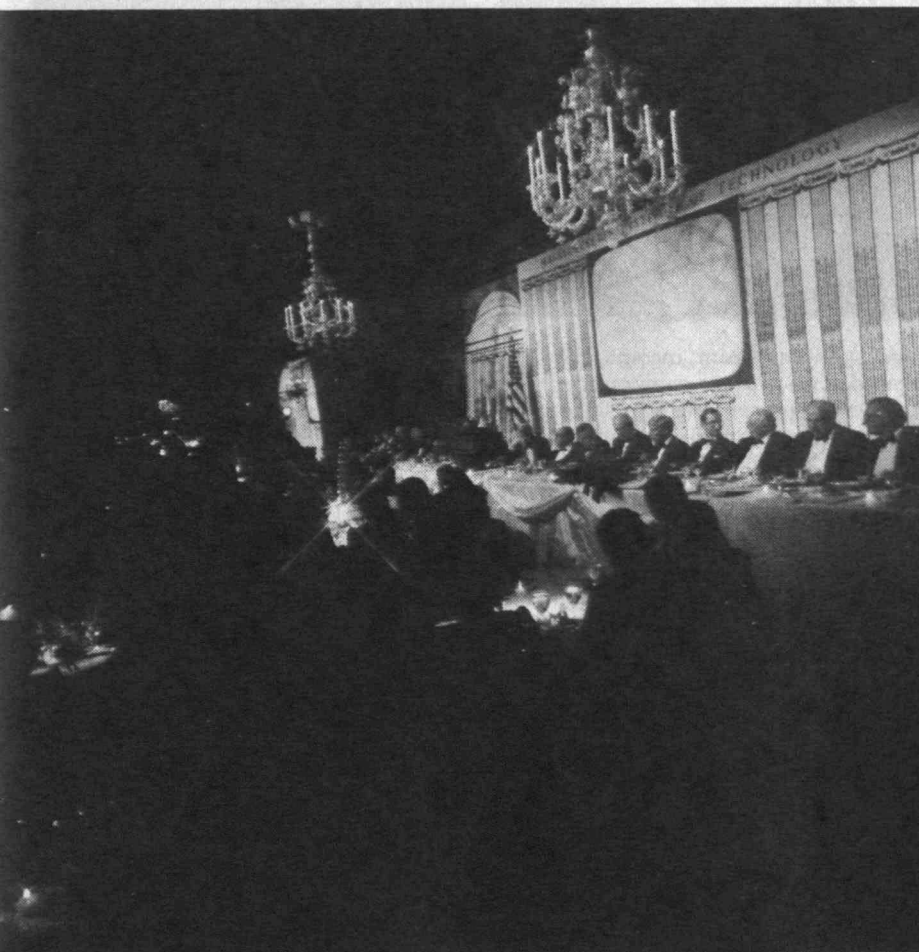
Guest of honor and main speaker was John S. Reed, '61, chairman and CEO of Citicorp and its subsidiary, Citibank. One financial analyst has referred to Reed as "probably the No. 1 banker in America in terms of knowledge and experience in applying technology to the financial services business," and he is credited with managing a marriage of electronics with consumer banking. □



• (Top, from left) John Castle, '63, chairman of the Gala Dinner Dance, given by the M.I.T. Alumni Center of New York, greets Priscilla Gray and President Paul E. Gray, '54. • Enjoying the congenial company on the dais were (center, from left) F. Helmut Weymar, '58, and Robert Carswell. • (Opposite, from left) Frederick H. Joseph and Peter Saint Germain, '48, chairman of the Alumni Fund Board.



(Clockwise from immediate left)
 ● Dinner dance chairman John Castle, '63, (glasses) presents a crystal beaver to guest of honor John S. Reed, '61. ● "Bob Hope," and "Barbra Streisand" emphasized that the order of the evening was a good time. ● The Grand Ballroom of the Pierre Hotel decorated with representations of the pillars and domes that are M.I.T.'s trademarks, included a screen in readiness for video productions featuring the Institute's space pioneers, its Nobel history, and the role of communications technology in banking. (Rumor has it algebraic geometry was used to maximize the number of tables in the room, so fewer people would have to be turned away.) ● The dais brought together corporate sponsors and members of the board of the N.Y. Alumni Center like Stephen P. Kaufman, '63, and Karen Arenson, '70.



Treasurer Strehle to Head Development

Glenn P. Strehle, '58, who has achieved a record of effective financial management as treasurer of the M.I.T. Corporation since 1975, now has added major new responsibilities as vice-president and treasurer of the Institute.

In his new assignment, Strehle retains the treasurer's role in managing M.I.T.'s invested funds and endowment while succeeding Samuel A. Goldblith, '40, who retired as vice-president—resource development on March 1.

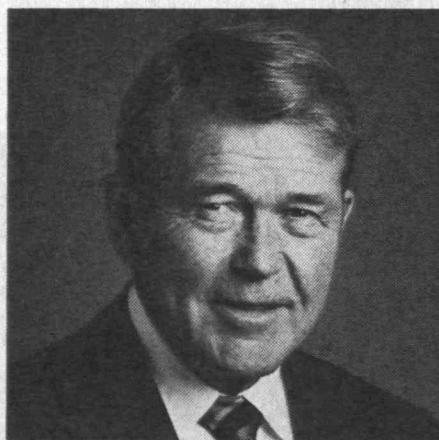
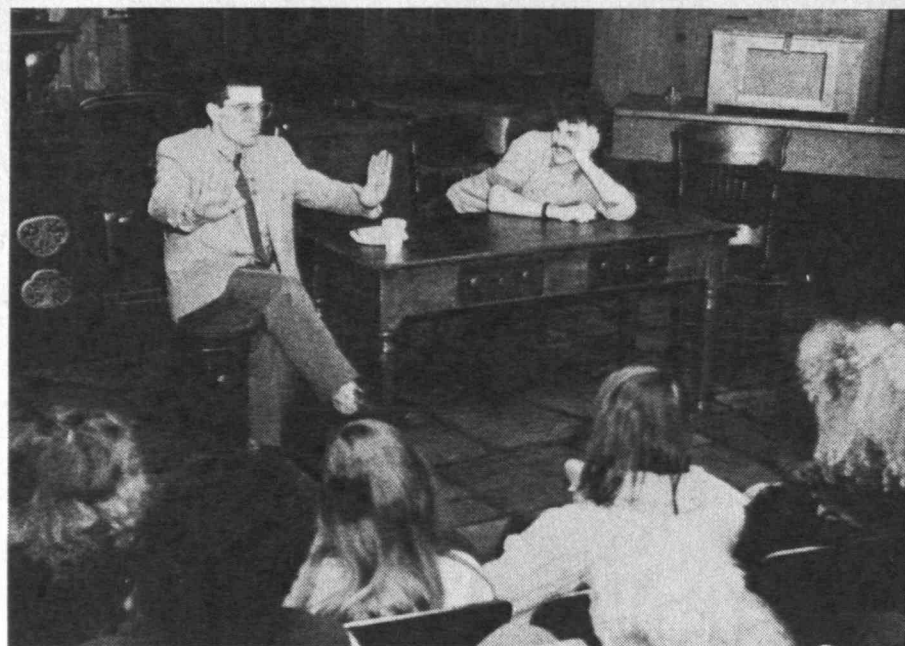
Strehle's new tasks include direction of M.I.T.'s development program, including the Industrial Liaison Program and the offices and volunteers involved in Institute fund-raising. With the new assignment comes major responsibility for a capital campaign to increase endowment that is expected to be announced early in 1987.

Fighting the Inroads of Inflation

As treasurer, Strehle is no stranger to the Institute's need for greater endowment resources. For more than a decade he has sought as treasurer to conserve the real value of the endowment while maximizing resources available to offset the inroads of inflation on educational programs.

More than five years ago he foresaw the needs that motivate the planning for a new capital campaign, noting the declining proportion of M.I.T.'s rapidly increasing educational expenses that could be supported by existing levels of endowment income. But he held firm against temptations to increase spending from the endowment to meet current needs. "Matching spending policy with real returns would seem an important measure of prudent investment and financial management," he wrote at the height of the inflation-driven pressure on Institute finances.

Under his management, the market value of endowment and similar funds,



after spending from income, has increased at an average compounded rate of almost 13 percent per year since 1978.

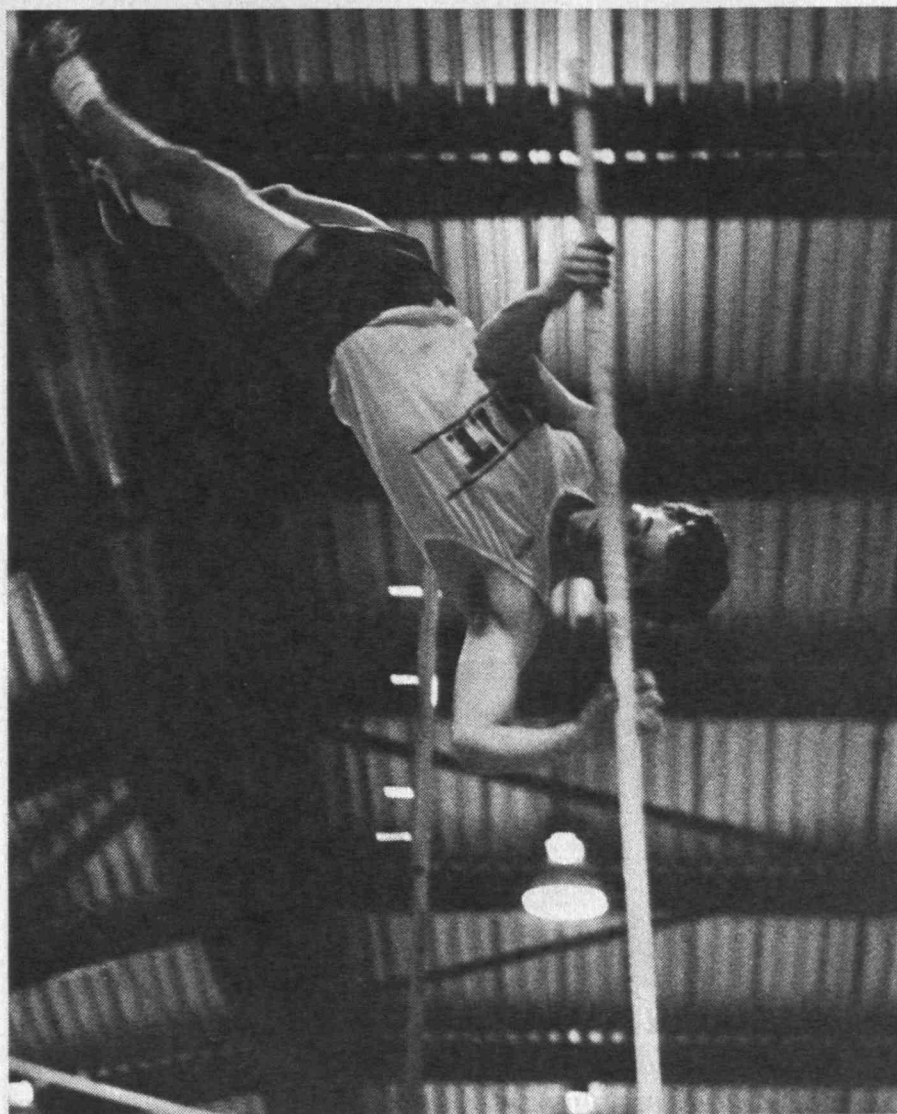
Strehle was named treasurer of the Corporation in 1975; at the time he was vice-president, director, and a member of the executive committee of Colonial Management Associates, Inc., Boston. He is now trustee and chairman of The Common Fund for nonprofit organizations, Fairfield, Conn., and a director of several Boston-area financial and technology companies.

Strehle holds two degrees in management from M.I.T. As an undergraduate he was a member of Phi Mu Delta, active in athletics, and honored with a Karl Taylor Compton Award for significant contributions to undergraduate life. He returned to the Institute for graduate study (S.M. 1960) after military service, and then held administrative posts in several M.I.T. offices before joining Co-

(Immediately above) left: Glenn Strehle, '58, and William Hewlett, S.M. '36. (Top) Sitting amid a Dramashop stage set, Pulitzer Prize-winning playwright David Mammet shared the convictions gained from years of acting and playwriting with members of Robert Scanlon's directing class in March.

lonial Management Associates in 1962 as a security analyst.

Active in alumni affairs, Strehle has been vice-president of the Alumni Association (1971-73), chairman of its Club Advisory Board (1971-74), and president of the M.I.T. Club of Boston. He has also served as an alumni member of the M.I.T. Athletic Board and chairman of the Alumni Interfraternity Council steering committee. He holds the Bronze Beaver (1973) for outstanding alumni contributions. □



The indoor track team swept to its third straight winning season in 1985-86, and won the New England Division III championship for the fourth time in seven years. Pole vaulter Robert White, '87 (left), was an outstanding contributor. Among other successes, White was only the fourth M.I.T. athlete to win his event in the 27-year history of the Greater Boston Conference Indoor Track & Field Championships.

Research Up

Total on-campus sponsored research in the 1985 fiscal year was \$241.7 million, up 9.1 percent from 1984. And of that total, a record \$33.5 million came from industry, up a stunning 20.7 percent over the \$27.7 million in support from industry during 1984.

In terms of constant dollars, campus sponsored research was up 5.1 percent in 1985. It was the second consecutive year of real growth for campus research, says Robert M. Dankese, M.I.T. budget director.

The four largest sponsors of campus research were the same in 1985 as in 1984: the Department of Energy, the Department of Health and Human Services, the Department of Defense, and the National Science Foundation. □

Rhodes Scholar

Marc Powell of Quebec City, Quebec, who is a graduate student in electrical engineering at M.I.T., will study at Oxford next year on a Rhodes Scholarship. Powell applied for the prestigious award from the Université Laval of Quebec, where he received a B.Sc. degree in engineering physics last May.

Powell will study engineering, economics, and management at Oxford, and he says he expects to return to M.I.T. for his doctorate in electrical engineering.

Hewlett to Speak At Commencement

A long-standing tradition will be renewed at the 1986 commencement exercises on June 2 when members of the 50-year Class of 1936 are guests of honor in the audience. They'll hear one of their own, William R. Hewlett, S.M.'36, vice-chairman of the board of Hewlett-Packard Co., speak to more than 1,500 graduates and about 6,000 parents and guests.

The tradition of members of the 50-year class as guests at commencement, abandoned in 1979 when the exercises were moved from Rockwell Cage to the Killian Court, will be restored this year. Some 50 members of the Class of 1936, wearing the red jackets which are the mark of their seniority, will march in the

procession and sit in a special section.

It was three years after Hewlett received his master's degree that he and Stanford classmate David Packard formed the Hewlett-Packard Co. Their first product was an audio oscillator based on an imaginative design that Hewlett had conceived while at M.I.T. The company started business with just over \$500 in capital, renting a small garage in Palo Alto, Calif. Since then it's grown to employ 82,000 people and its 1984 sales were \$6.04 billion.

Hewlett took the title of vice-president of the company in 1947; he became its president in 1964 and chief executive officer in 1969, titles which he gave up in 1977 and 1978, respectively.

Hewlett holds honorary degrees from Yale, Dartmouth, Johns Hopkins, and six other colleges. In 1985 he received the National Medal of Science, the nation's highest scientific honor.

Ronald Erwin McNair, 1950-1986: Hanging It Over the Edge

Oh my God! Ron was up there!" Hundreds at M.I.T. will remember the moment on January 28 when that realization came to them—a moment of sudden, stark tragedy that for those whose lives he touched will remain almost as compelling as the instant of learning about the assassination of President Kennedy in 1963.

For five M.I.T. students, members of the Concert Band on a Florida tour, that moment was at Cape Canaveral. They had driven all night to see the launch, and suddenly there was only the smoke in the sky. "The strangest thing," recalls graduate student Charles Marge—"it was crystal clear, no wind. And that cloud hung in the sky all day. . . . And it was *that* cloud because there was nothing else in the sky all day."

"I Really Think I Can Do This . . ."

Even before he became an astronaut, Ronald E. McNair, Ph.D. '76, had made a series of outsize steps toward greatness. He was valedictorian of his high school class, a star athlete, and a talented saxophonist in the high school band. McNair first came to M.I.T. in 1969 on a junior-year exchange scholarship from North Carolina A&T, a predominantly black college not far from his home in Lake City, S.C. The decision to leave his familiar, secure North Carolina college for the somewhat intimidating rigor of M.I.T. was one of the first challenges he accepted on the way to his goals.

In that year at M.I.T. McNair gained the reputation of a hard worker determined to succeed. A year later, having finished a *magna cum laude* physics degree at North Carolina A&T, McNair was back at the Institute for graduate work. Professor Michael S. Feld, '63, with whom McNair did his doctor's thesis on laser spectroscopy, remembers that McNair's background for graduate work was "quite deficient." But McNair worked "very, very hard," says Feld, finished his doctorate with success, and went on to take a job at Hughes Research Laboratories in Malibu.



"He looked to the future and made a down payment with his commitment."

McNair's doctoral thesis at M.I.T. was on the effects of laser irradiation on various chemical molecules. His work at Hughes focused on the uses of lasers in space—for satellite to satellite communications and for remote sensing.

McNair also brought science to his hobby of martial arts, showing how karate was built upon its practitioners' precise but intuitive knowledge of the physics of the human body. Indeed, he and Feld were twice partners in presenting this subject in symposia on the physics of everyday experience at meetings of the American Association for the Advancement of Science.

As a graduate student McNair lived in a black neighborhood in Boston and worked with inner-city youth through karate classes and in many other ways.

"It was clear that Ron knew how to motivate and influence young people. He could relate to them very well," recalls Clarence G. Williams, special assistant to the president of M.I.T.

Williams also remembers talking about the shuttle astronaut program with McNair as he was finishing his work at the Institute. "I really think I can do this thing," McNair told him, and Williams remembers thinking that McNair was a natural for it.

"Hanging It Over the Edge"

McNair's determination to conquer obstacles and challenges was the recurring theme of the moving memorial tribute that brought close to 1,000 members of the Institute community to Kresge Auditorium on February 12. A persistent subtheme was his faith and his commitment to the St. Paul AME Church of Cambridge.

"I remember when we were planning a symposium here to celebrate his first shuttle flight," said Feld at the service. "I asked McNair what title he would choose for his lecture, and he said, 'I've got a kind of crazy idea for a title—'Being a Winner: Hanging It Over the Edge.'"

At the time that puzzled Feld, but not now. "Hanging it over the edge," said Feld, "means setting the most daring personal goal you can possibly hope to reach, and then devoting all your powers of mind and body and spirit to achieving it . . . daring to go to the limits of one's abilities, and perhaps a little beyond."

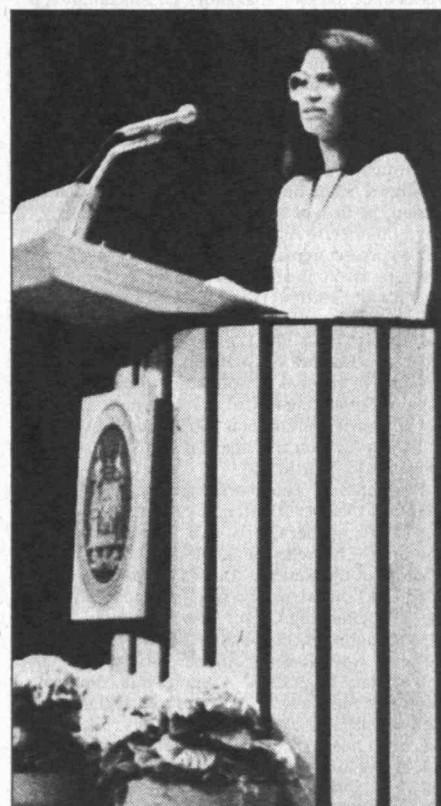
President Paul E. Gray, '54, focused on those same qualities at the memorial: "Ron understood instinctively that he represented, for a whole generation of younger people at M.I.T. and around the nation, a symbol, a shining example of what dedication and risk-taking and hard work and faith and self-confidence could achieve."

That McNair's was a life-long mission was made clear when Professor J. David Waugh, dean of the Engineering School at the University of South Carolina, revealed after the tragedy that McNair



Ron McNair's message, said his wife Cheryl (right, addressing the memorial throng at Kresge), was that each person's task is to "strive to achieve your goal, then turn around and help others achieve their

goals." As an astronaut mission specialist and as a recruiter, role model, counsellor, and cheering section for minority and other students (above, right), McNair lived by this credo.



would likely have taken a faculty post there starting next summer. "Although he never quite said it," Waugh told Dudley Clendinen of the *New York Times*, McNair made it clear "that blacks don't grow up and prosper and move away—they go away and prosper and come back. . . . He was going to make that statement—that you don't have to make the exodus," Waugh said.

"To Make the World a Better Place . . ."

But the most moving reflection of McNair's commitment came when his wife Cheryl—whom McNair had met and married in Boston—unexpectedly asked to add her own tribute during the M.I.T. memorial service. She spoke in a voice so hushed with controlled emotion

that the audience, barely breathing, strained to catch every word.

Cheryl McNair affirmed that her husband had been where he wanted to be, doing what he most believed in doing. She read a message that McNair had intended to broadcast from space while orbiting in *Challenger*:

"Over the past 25 years space travelers have reportedly spoken of the astounding beauty of earth as seen from the unique perspective of space. . . . It just so happens that I brought along my soprano saxophone. . . . I wish to present to you a medley of songs . . . dedicated to every man, woman, and child on every continent on the planet. [The first song] offers a solution to the malice that exists among us. The second song addresses what we as individuals can do

to make the world a better place for everyone."

The songs he would play were "What the World Needs Now Is Love, Sweet Love" and "Reach Out and Touch Somebody's Hand." His home-made recording of these songs, a tape left with Cheryl before McNair joined his fellow-travelers on *Challenger*, filled Kresge Auditorium with the poignant sound of a solitary saxophone.

Eyes moist, nearly 1,000 members of the M.I.T. community held hands in tribute to McNair's vision. "It has the power to inspire, the power to cause people to achieve impossible goals," said Gray. "His is the contribution of the greater teacher—a contribution that persists from generation to generation, and we are his acolytes."—*John Mattill* □

NEWS FROM THE DEPARTMENTS

I CIVIL ENGINEERING

Assistant Professor **Alexander H. Slocum**, '82, is now the George Macomber Career Development Professor in Construction Management, a chair created by a gift of **George Macomber**, '48, president of the George B. H. Macomber Co., Boston. Slocum, who retains an association with the National Bureau of Standards where he has worked since 1983, is starting new research at M.I.T. in construction automation.

Miguel Stanichevsky, S.M.'82, reports that he joined the firm of N. Stryvalin and Associates, Civil Engineers, Asuncion, Paraguay, last November as project manager. Stanichevsky is also teaching two one-semester courses in soil mechanics and earthworks at the Catholic University School of Technology, and notes that he would like to enroll in a Ph.D. program in September 1986. . . . **Roland V. Geoffrois**, S.M.'68, writes, "After five years as a production manager in the Zakum Development Co. in Abu Dhabi, I am being transferred to Total Oil Marine in Aberdeen (U.K.) as division manager for the North Alwyn oil/gas field (North Sea)."

Rear Admiral **Thomas S. Maddock**, S.M.'51, retired last October 30 after 33 years of service with the Civil Engineer Corps, U.S. Naval Reserve. At the time of his retirement, Maddock was commander of the Reserve Naval Construction Force. Maddock, president and chief executive officer of Boyle Engineering Corp., Newport Beach, Calif., also relinquished his position of vice-president-at-large for Navy Reserve Affairs, Society of American Military Engineers. Maddock was commissioned in the Navy in 1952 and joined the Naval Reserve in 1957. . . . **David A. Peters**, S.M.'77, has been named vice-president and associate for marketing and business development at Symmes, Maini and McKee Associates, Inc., architects, engineers and planners in Cambridge. Peters formerly served as vice-president and director of marketing for the LEA Group, Boston, an architectural firm. . . . **William S. Zoino**, S.M.'54, a principal of Goldberg-Zoino and Associates, Inc., Newton, Mass., a geotechnical geohydrological consulting firm, was installed as vice-president of the American Society of Civil Engineers (ASCE) last October. Zoino will serve a two-year term on the Board of Directors and will represent Zone I, consisting of the Northeastern United States.

William Streat, S.M.'49, was recently honored by the Architectural Engineering Society for his 36 years of service as professor and chairman of the Architectural Engineering Department at North Carolina A&T University, and also for his contributions to the field. Streat retired from the university last August; during his teaching career he had been honored by, among others, the United Negro College Fund and the North Carolina chapter of the American Institute of Architects.

. . . **Harold K. Crowder**, S.M.'32, of Parma, Ohio, professor emeritus at Case Western Reserve University, passed away on July 5, 1985; no further details are available.

II MECHANICAL ENGINEERING

Dwight E. Beach, Jr., S.M.'65, is president of Houston Engineers, Inc., and of Wilson Downhole Services. . . . **J.P. Barger**, S.M.'50, president and chief executive officer of Dynatech Corp., Burlington, Mass., had been elected a director of Spartacus, Inc., Bedford, Mass. . . . **Michael Connolly**, S.M.'82, reports that he is "serving on active duty as navy lieutenant, currently assigned to teaching physics at the U.S. Naval Academy, Annapolis, Md. Mailing address: Physics Department, USNA, Annapolis Md., 21402-5001." . . . **T. Y. Chow**, S.M.'48, writes, "I will retire from teaching as professor of mathematics, California State University, Sacramento, some time in 1986."

John Stopford, S.M.'62, writes, "I have just had a new book published, *Britain and the Multinationals* (John Wiley). Though most of the arguments apply to conditions in England, some also apply to the United States, for both countries have difficulties in adjusting to new forms of international competition. Though most of my time is devoted to managerial issues, I have not abandoned all that I learned in Course II, as I sit on the board of Webtec Industrial Technology, Ltd., owned by a classmate **George Weir**, S.M.'62. We fund new technological projects with a view to making them into new businesses." . . . **David K. Felbeck**, Sc.D.'49, professor of mechanical engineering at the University of Michigan, Ann Arbor, was elected a fellow of the ASME in 1985.

Bulent E. Platin, Sc.D.'78, was appointed associate professor (a tenure position) in the Mechanical Engineering Department of the Middle East Technical University in Ankara, Turkey in 1985. . . . **Peter Kalustian**, S.M.'34, reports, "Still very actively involved in my process engineering consulting business. My health continues to be excellent and I am looking forward to some downhill skiing." . . . **Mark Kniffin**, S.M.'81, reports that he is working in research and development for Digital Equipment Corp., on high-performance VAX design.

Four deaths have been reported to the Alumni Association with no further details available:

Charles N. Griffiths, Sr., S.M.'47, former president of the Binghamton Slag Roof Co., Binghamton, N.Y., on November 22, 1985; **Frederick R. Gruner**, S.M.'41, of Green Valley, Ariz., on October 27, 1985; **Alwin B. Newton**, S.M.'32, who practiced as a professional engineering in York, Pa., where he died on October 29, 1985; and **William J. Suchors**, S.M.'35, of Jacksonville, Fla., on March 19, 1985.

III MATERIALS SCIENCE AND ENGINEERING

Eugene Meierar, Sc.D.'63, manager of quality assurance at Intel Corp, Santa Clara, Calif., was given the Distinguished Purdue Alumni Award last December. . . . **John Zotos**, Mt.E.'67, has been promoted to full professor of mechanical engineering at Northeastern University, Boston and in October 1985 became a 25-year associate at that

institution. . . . **John H. Walsh**, Sc.D.'55, retired (after a period of ill health) from the Canada Department of Energy, Mines and Resources in 1985 after 30 years of service.

Brinton W. Corb, Sc.D.'83, has returned from Basel, Switzerland, where he served a two-year postdoctoral position in the Physics Department of Basel University. Corb has accepted a permanent research staff post at Kodak Research Laboratories/Spin Physics, San Diego, where he is studying the physics of magnetic recording.

With apologies, we correct our reporting (November/December, p. A13) of the death of **Myron P. Lepie**; Lepie held two degrees in metallurgy from M.I.T.—S.M. (1958) and Sc.D. (1960). Lepie had retired after a career with Raytheon; Mrs. Lepie is now a resident of Laguna Hills, Calif.

IV ARCHITECTURE

Ranko Bon, Ph.D.'75, assistant professor of economics in architecture at M.I.T., now holds a George Macomber Development Professorship in Construction Management. Bon is working on a comprehensive office building design system (a project sponsored by IBM) and on preventive building maintenance; his professorship is the result of a gift by **George Macomber**, '48, president of the George B. H. Macomber Co. of Boston.

Ronald R. Williams, M.Arch.'62, has been promoted to senior vice-president, manager of health care facilities at Hellmuth, Obata and Kassabaum, Inc., St. Louis, Mo.; architecture, interiors, planning, graphics, and engineering. Williams is currently officer-in-charge of St. Louis University Hospitals' expansion program, as well as several other major teaching hospital renewal projects in various parts of the U.S. . . . **Norris Strawbridge**, M.Arch.'76, who was recently named a principal of Sasaki Associates, Inc., Watertown, Mass., has joined the firm's Coral Gables office as principal-in-charge of architectural services. In previous Sasaki assignments, he has been project designer for Virginia Center and has been responsible for several academic master plans.

Robert S. Allan, M.Arch.'55, writes that his architectural and consulting firm completed a hospital early this year. Currently, he notes, "we are completing plans for a very interesting church where we have attempted to solve (visually) some of the complex problems caused by our changing society." . . . **Everett A. Glendening**, M.Arch.'54, who practices in Cincinnati, reports that he is architect for a new geology/physics science center (\$12,000,000) at the University of Cincinnati, scheduled for completion during the summer of 1987. Glendening also notes with fatherly pride that his son James passed the state boards and is now a "second-generation" registered architect in Minneapolis. . . . **W. L. Garvin**, M.Arch.'58, is currently university architect and director of the Facilities Planning Office at Kansas State University. Previously, Garvin was associate dean and chairman of the Division of Architecture at Texas Tech University.

John Sullivan, Jr., M.Arch.'38, recounts his

1985 adventures in a way that will make most readers envious: "I spent February at the Silverado Golf Club, Napa, Calif.; March at the Keywayden Club in Florida; May to August, in Europe painting, drawing, and traveling; and a wedding . . . Ireland for two weeks . . . Paris in June, where I have an apartment, then drove south to Biarritz (Basque country) and back to Ronchamps and visited friends in Munich. Spent two weeks in Vermont in October and am going to Australia again in January." . . . **James A.**

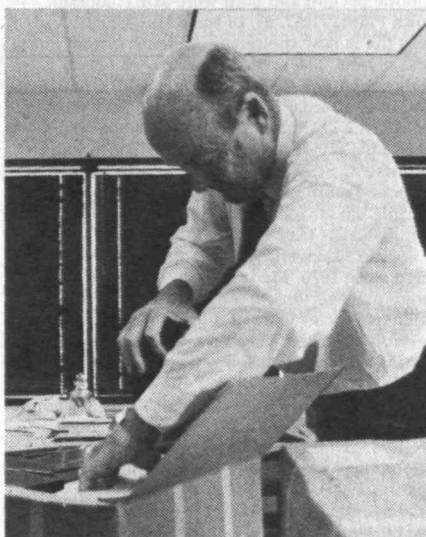
Carr, M.Arch.'72, is a partner in the architectural firm of J. Gordon Carr and Associates, P.C., located at: 80 West 40th St., New York, N.Y. 10018.

Luis Dorich, M.C.P.'44, writes, "Ever since I went back to my country, Peru, I have practiced city planning in my private office. From 1947 to 1964 I was director of the National Planning Office and also professor in urban studies at the National University of Engineering. From 1964 to 1971 I was appointed regional consultant in housing and urbanization by the Pan American Health Organization. From 1971 to date, I work as short-term consultant for different international organizations (UN, PAHO, WHO, OAS, and others). From 1980 to date, I am president of the Board of Directors of the National Institute for Urban Development. Last year I was appointed a member of the International Expert Committee on Sanitary Aspects of Housing and Urbanization by the World Health Organization." . . . From Lexington, Mass., **Neville Anthony Powers, M.Arch.'72**, reports highlights of his year 1985: "Joined PRIME Computer Inc.'s CAD/CAM group as principal engineer (July 15); exhibited one of my paintings in a show in Provincetown (November); my son Llewellyn Powers was nine on July 12, and he is a hockey player, painter, and computer whiz. I am enjoying being a single parent."

V CHEMISTRY

Elias J. Corey, Ph.D.'48, professor of organic chemistry at Harvard University who is described as "one of the leading figures of his generation in synthetic organic chemistry" was honored with the 1985 V.D. Mattia Award for distinguished biomedical research by the Roche Institute of Molecular Biology, Nutley, N.J. Corey was cited for his "unique and profound influence on the entire field of organic chemistry," including an "innovative approach to the methodology of organic synthesis." . . . **Lee B. Jones, Ph.D.'64**, has recently accepted the position of executive vice-president and provost at the University of Nebraska, Lincoln. . . . **David M. Hercules, Ph.D.'57**, professor and chairman of the Chemistry Department at the University of Pittsburgh, will receive the 1986 American Chemical Society Award in Analytical Chemistry at the ACS national meeting in New York in April.

Edward G. Kelly, Ph.D.'69, has been appointed to the business administration faculty at Franklin and Marshall College, Lancaster, Penn., and is also pursuing a doctorate in accounting from the University of Pennsylvania's Wharton School. . . . **Karl G. Brandt, Ph.D.'64**, became



A milestone for Herbert H. Woodson, '51, director of the Center for Energy Studies at the University of Texas, Austin: new quarters for the center, including its first laboratory facilities. "A wonderful place to be, a momentous time for us," said Woodson as he moved in.

acting dean of agriculture at Purdue University, West Lafayette, Ind., last January 1. Brandt, a faculty member at Purdue since 1966, was formerly associate dean and director of resident instruction of the School of Agriculture and professor of biochemistry.

C. James Bier, Ph.D.'71, writes, "Spent five weeks in June and July 1985 with the Nuevo Instituto de Centro America and at Esteli, Nicaragua, in intensive language, cultural, and political education. United States government policy toward Nicaragua," writes Bier, "is immoral, illegal, counterproductive, and is seen as mercenary terrorism against a free people struggling to build a better life." . . . **Chris Orvig, Ph.D.'81**, has assumed his new position on the faculty at the University of British Columbia as Natural Sciences and Engineering Research Council Fellow.

Tung Po Lin, Ph.D.'58, has been appointed director of the China Institute at California State University, Northridge. "Since I'm still teaching full-time in the Mathematics Department," writes Lin, "I wish that there were 25 hours in a day to do the work." . . . **Arthur M. Poskanzer, Ph.D.'57**, senior chemist at the Lawrence Berkeley Laboratory, University of California, received an Alexander von Humboldt Senior Fellowship and will spend a year at the GSI Laboratory at Darmstadt, West Germany. . . . **John E. Wood III, Ph.D.'39**, whose was associated with Vulcan Materials Co. of Birmingham, Ala., passed away in

Birmingham on December 7, 1985; no further details are available.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

M.I.T.'s Assistant Professor **David Edell** made *Esquire* Magazine's 1985 list of "men and women under 40 who are changing the nation." His achievement as *Esquire* describes it: "a tiny implantable silicon chip . . . that taps directly into the nervous system and picks up electrical currents that race from the brain down nerve fibers to (amputees') missing muscles."

Mildred S. Dresselhaus, Abby Rockefeller Mauze Professor in the department, has received the ultimate accolade of her M.I.T. faculty colleagues: election to Institute Professor, the first woman to be so honored. Professor Dresselhaus, who has faculty appointments in both electrical engineering and physics, is a specialist in the electronic, optical, and magneto-optical properties of semiconductors and semimetals. She's also widely known as an active advocate of wider opportunities for women in science and engineering.

From his vantage point as vice-president of the Process Systems Division at Lisp Machine, Inc., **Robert Moore, Ph.D.'71**, says artificial intelligence will soon have a major role in process control. Widespread use of computers means that many process parameters are now measured routinely—so many that human operators can no longer successfully control all of the variables. AI is needed, he says, to "help the operator deal with a complex or emergency situation."

Henry N. Bowes, S.M.'44, an engineering and science program manager for Lockheed Engineering and Management Services Co., Houston, has been awarded the Philip T. Sprague Award of the Instrument Society of America. Bowe was recognized for his "outstanding contributions to the development and implementation of advanced instrumentation and control systems in the aerospace industry." Bowes has been a principal in Lockheed's work on NASA's Skylab, Earth Resources, and Space Shuttle Programs. . . . **R. Gene Shelley, S.M.'49**, senior vice-president and general manager of Raytheon's Equipment Division, will become president of Raytheon Co. in May. Shelley joined Raytheon in 1964 after work at North American Aviation and as president of Standard Aircraft Radio Co., Los Angeles. . . . **Richard J. Schwartz, Sc.D.'59**, professor of electrical engineering at Purdue University, West Lafayette, Ind., was appointed head of the School of Electrical Engineering last October.

After three years at Arizona State University, Tempe, **Craig W. Kirkwood, Ph.D.'68**, chairman of the Department of Decision and Information Systems, has been named acting dean of the University's College of Business. . . . **Michael S. Adler, Ph.D.'71**, manager of the Power Electronics Laboratory at the General Electric Research and Development Center, Schenectady, N.Y., was presented with one of the Center's gold patent medallions honoring the milestone of his 20th patent application.

Ed Ostroff, '51, of Raytheon's Radar and Ship

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Mark X. Haley '75
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Andrew F. McKown '78
Keith E. Johnson '80

Systems Division, chaired the "Phased Arrays '85" Symposium at Mitre Corp. last October; he is co-author of *Solid State Radar Transmitters*, a book published by Artech House, Dedham, Mass. (December 1985). . . . **Thomas J. Lynch**, S.M.'59, has written *Data Compression Techniques and Applications* (Van Nostrand Reinhold, 1985). . . . **Garry S. Meyer**, S.M.'72, writes that he is vice-president for the Data Management Debt Rating Division of Standard and Poor's Corp., New York City, and he and his wife Ellen have three children and are living in Stamford, Conn.

C.H.R. Campling, S.M.'48, writes, "It may have some minor interest that when the IEEE Centennial Medals were awarded in 1984, two of them were given to members of IEEE's Bay of Quinte Section and both were M.I.T. alumni. **John Plant**, Ph.D.'65, of the Royal Military College (he is now the senior academic official there) and myself. The section embraces Kingston, Peterborough and Belleville. (Ontario)." . . . **Alberto Ospina-Taborda**, S.M.'58, writes, "As a member of the M.I.T. Club of Colombia, I am working with **Luis Javier Mira**, '72, and **Oliverio Phillips**, (Course X, Sc.D.'57), to establish the M.I.T. Enterprise Forum of Colombia." . . . **Dean H. Vanderbilt**, Ph.D.'70, was elected for a second term on the Dallas City Council last April.

John P. Tazwell, S.M.'51, writes, "I've been retired since 1970. My last job in the Navy was program manager for the Aegis Program. Now I do some volunteer work and travel. My wife and I recently returned from a trip around the world during which we visited my son who works for the Peace Corps in Nepal. I enjoy keeping up with things at M.I.T. through *Technology Review*." . . . **Eni G. Njoku**, Ph.D.'76, reports, "I was recently (November 1985) awarded the National Aeronautics and Space Administration (NASA) Exceptional Service Medal for contributions to microwave remote sensing of the earth from space. I am currently a member of the technical staff at Jet Propulsion Laboratory, Pasadena, Calif. In June, I will be moving to Washington, D.C. to become program manager for ocean data systems at NASA headquarters." . . . **William W. Wu**, S.M.'67, reports that he received a Ph.D. from Johns Hopkins University; is author of *Elements of Digital Satellite Communications* Volume I (1984) and Volume II (1985), published by Computer Science Press; is editor of *Advances in Satellite Communication*; and is editor for satellite communication of *IEEE Transactions On Communications*.

VI-A Internship Program

The 1986 VI-A orientation and selection process began with the annual "Orientation Lecture" on February 5. Some 200 potential candidates attended. Professor **Richard B. Adler**, '43, associate department head for Electrical Science and Engineering, spoke briefly about VI-A's academic role and Associate Director **Kevin J. O'Toole**, '57, covered "how the program operates." Mr. Tucker chaired the meeting and covered the selection process and how to apply. It looks as if VI-A will experience another high demand year and the final statistic will appear in a later issue.

Added to the program this year will be a graduate VI-A assignment at DEC's Western Research Laboratory, Palo Alto, Calif. Also, the Naval Surface Weapons Center's White Oak Laboratory, Silver Spring, Md., will resume taking new students this year. Earlier in the fall term, RCA's Astro-Electronics (Space Center) Division, Hightstown, N.J., informed us that they would be withdrawing from the program by not taking any new students but allowing those currently enrolled to complete their assignments for graduation.

Decisions on admission of VI-A seniors to the graduate phase of VI-A, starting June 1986, are 99 percent complete. Seventy-two of the 106 VI-A seniors (67.9 percent) have been advised of their admissibility. Forty-five of these are in the "SM-only" category. Of the total VI-A seniors, 82 applied and 87.8 percent of these were accepted.

Harold S. Osborne, '08 died recently at the age of 98. Although not in VI-A, it is interesting to note that he was the first one in M.I.T.'s School of Engineering to be awarded a Doctor of Engineering degree (in 1910). He was in Course VI which, then, was under the headship of Professor **Dugald C. Jackson**. Only five other such degrees were awarded by the department up through 1918. These early recipients of the EngD were then offered replacement ScD's, but three decided to keep their original EngD's, amongst them **Harold Osborne** and **Vannevar Bush**, '16. Mr. Osborne later rose in the Bell System to become chief engineer of the AT&T Co.

Another alumnus, with whom I was personally acquainted and worked under while employed by the Bell System, died December 12, 1985—**Winthrop F. Potter**, '22, of Lexington, Mass. "Win" Potter graduated from VI-A with a Master's degree and worked for the New England Telephone and Telegraph Co. until his retirement as chief engineer. He was 84 at the time of his death.

In the list of 1986 IEEE Fellow Awards, we are proud to see the names of two VI-A alumni among the 11 new fellows from the Boston area. One is **Bruce D. Wedlock**, '56, director of M.I.T.'s Lowell Institute School. His citation is "for contributions and leadership in electrical engineering education."

The other alumnus receiving the IEEE Fellow distinction is **Arthur C. M. Chen**, '61, of General Electric Co.'s Corporate R&D Laboratories, Schenectady, N.Y. Arthur's citation reads: "For contributions to the application of computer technology in medical electronics and to the automation of electric power distribution systems." Arthur is manager of the Interactive Systems Laboratory at General Electric. He stopped by the VI-A Office to see us during a recent M.I.T. visit.

Thomas H. Crystal, '59, whose son **Michael R.**, '86, is currently doing his VI-A graduate work at Fairchild's Palo Alto Research Center, has been elected chairman of the Acoustics, Speech and Signal Processing Society of the IEEE, effective January 1, 1986. Tom is affiliated with the research staff of the Institute for Defense Analyses, Princeton, N.J. . . . Also, in connection with the IEEE we noted an announcement that **Norman D. Wittels**, '69, spoke at the Boston Section's Robotics Chapter on "Machine Vision Application Engineering." "Norm," who is now a consultant, was cofounder of Automatix, Inc.

During the Christmas holidays we had a visit from **Edward C. Giaimo**, '74, of Seattle, Wash. "Biff" is engineering manager and board member of Zetron, Inc. While here he had a business meeting with two VI-A's who are founders of Brooktrout Technology, Inc., Wellesley, Mass.—**David W. Duehren**, '80, vice-president—R&D, and **Patrick T. Hynes**, '81, vice-president—engineering.

Stopping by for a visit in January, while giving a tour of M.I.T. to his brother, was **Michael W. Patrick**, '80, who is now living in the Cambridge area. . . . Another office visitor, who gave us a demonstration of his latest product, was **Michael T. Howard**, '82. He and a partner have joined Datext, Inc., Woburn, Mass. Mike informed us that **Allen K. Wells**, '80, has also joined Datext.

Steven L. Bates, '74, product engineering manager at GenRad, is their VI-A technical co-ordinator. He came to M.I.T. at the end of January to meet with **Kevin J. O'Toole**, '57, and **John A. Tucker** to discuss changes in the company and plans for their VI-A involvement in this year's selection process.—**John A. Tucker**, Director, VI-A Internship Program, M.I.T., Room 38-473, Cambridge, MA 02139

VII BIOLOGY

M.I.T. Professors **H. Robert Horvitz** and **Richard C. Mulligan** were among *Esquire* magazine's 1985 list of "men and women under 40 who are changing the nation"—Horvitz for his nematode research into the role of genetics in development,

Mulligan for his gene-transfer technique "that involves 'piggybacking' the genes into mice, using . . . retrovirus vectors." Mulligan was also cited for his interest, shared with three other microbiologists, in founding a Cambridge, Mass., brewery to make "real traditional British beer."

Russell K. Chan, Ph.D.'74, is currently a research scientist with the Microbial Genetics Division of Pioneer Hi-Bred International, Inc., Johnston, Iowa. . . . **Richard S. Gordon**, Ph.D.'54, is professor of agribusiness and biotechnology at Arizona State, after retiring from Monsanto. Gordon is also director of Arizona State's NEWCAST Center, involved in helping new technologies get shaped into new enterprises. . . . Dr. **Judith Wurtman**, research scientist in the department at M.I.T., and Dr. **Richard Wurtman**, professor and director of the M.I.T. Clinical Research Center, are conference co-chairs for the (June 19-21) 1986 Conference on Human Obesity sponsored by the New York Academy of Sciences. . . . Two alumni of the department have three-year appointments to faculty positions at Princeton University: **Iva Greenwald**, Ph.D.'83, assistant professor of biology; and **Mark Rose**, Ph.D.'83, assistant professor of molecular biology. . . . **Jacob Struck, Jr.**, Ph.D.'58, has been promoted from vice-president—research and product development to executive vice-president, chief operating officer, and director at Gamma Biologicals, Inc., Houston, Tex.

VIII PHYSICS

UCLA's Alix G. Mautner Memorial Lectures given last year by **Richard P. Feynman**, '39, have now been published in *QED: The Strange Theory of Light and Matter* by Princeton University Press. Mautner, who was assistant professor of English at California State University, had often asked Feynman, professor of physics at Caltech, for an explanation of modern physics for intelligent nonphysicists, and Feynman's Mautner Lectures are his response.

Carl S. Schneider, Ph.D.'69, has been appointed director of research for the U.S. Naval Academy, Annapolis, Md., and plans to use the Academy's growing PC network to disseminate information on research and funding activities. . . . **James E. Brall**, Ph.D.'70, has been granted tenure as associate professor in the Physics Department at the University of Tennessee. . . . **Nisson A. Finkelstein**, Ph.D.'49, of Wilmington, Del., was guest speaker at the Temple Shaare Tefilah, Norwood, Mass., last November. His subject matter was his summer travel to Russia and visit with a number of Russian Refuseniks, bringing back tapes and pictures of his meetings.

Hans Mark, Ph.D.'54, chancellor of the University of Texas system, has been named a member of Mitre Corp.'s Board of Trustees. . . . **Jack L. Uretsky**, Ph.D.'45, joined the faculty of Elmhurst College, Ill., as an associate professor of mathematics and computer science. In addition to his three degrees from M.I.T., Uretsky studied law at the University of Chicago and most recently was associated with a Chicago law firm specializing in intellectual property law. . . . Major **James F. DeBroux**, S.M.'79, writes that he "departed the Department of Physics at the U.S. Military Academy, West Point, N.Y., in July 1985 to attend the Air Command and Staff College at Maxwell Air Force Base, Montgomery, Ala. The mission of the school is to enhance the professional knowledge, skills, and perspectives of mid-career officers for increased leadership roles in command and staff positions. I will graduate in June 1986—next assignment unknown."

IX PSYCHOLOGY

Nancy Kanwisher, Ph.D.'85, holds a Social Sciences Research Council fellowship in international security financed by the MacArthur Foundation,

under which she is conducting postdoctoral work at Columbia. Kanwisher's M.I.T. thesis was in cognitive psychology, and she now wants to show how people in leadership roles make judgments and solve problems that affect international security, according to a *Boston Globe* interview.

X CHEMICAL ENGINEERING

Five alumni in the department were recognized at the American Institute of Chemical Engineers (AIChE) meeting in Chicago last November:

□ **James Wei**, Sc.D.'54, Warren K. Lewis Professor and chairman of the department at M.I.T., received the 1985 Warren K. Lewis Award for Contributions to Chemical Engineering Education. Wei was cited for his "scholarly contributions to chemical reaction engineering literature and his impact as an educator."

□ **P.L. Thibaut Brian**, Sc.D.'56, vice-president for engineering and a member of the board of directors at Air Products and Chemicals, Inc., Allentown, Pa., was elected to a three-year term as a director of AIChE.

□ **Thomas H. Pigford**, Sc.D.'48, professor and chairman of the Department of Nuclear Engineering at the University of California, Berkeley, received the 1985 Award for Service to Society. Pigford was honored for his key technical input to several government advisory boards, including the President's Commission on the Accident at Three Mile Island.

□ **Ronald E. Rosenweig**, Sc.D.'56, senior research associate with Exxon Research and Engineering Co.'s Corporate Research Laboratories, Annandale, N.J., received the 1985 Alpha Chi Sigma Award for Chemical Engineering Research. Rosenweig was recognized for his "fundamental studies of magnetic fluids and his efforts to bring the force of magnetism to bear in chemical engineering practice."

□ **Warren E. Stewart**, Sc.D.'51, McFarland-Bascom Professor of Chemical Engineering at the University of Wisconsin, Madison, won the Computing in Chemical Engineering Award, cited for developing "innovative computational techniques for process simulation, analysis and design."

Luther C. Chien, S.M.'47, a research manager in the Chemicals and Pigments Department of the Du Pont Co., Wilmington, Del., has been promoted to departmental fellow, the highest professional research level at Du Pont. He is responsible for chemical process technology development for Du Pont's Freon Products Division. . . . **Will Fraizer**, S.M.'80, is working as a senior chemical engineer for Chevron U.S.A., involved in planning for a major oil and gas processing plant in Santa Barbara County, Calif. . . . **William Hawthorne**, Sc.D.'39, has retired from his post as master of Churchill College, Cambridge, England (1968-83), where he is professor emeritus of applied thermodynamics; he continues as senior lecturer in the Aeronautics and Astronautics Department at M.I.T.

Sergio C. Trindade, Ph.D.'73, writes, "After four successful years as an international consultant in energy and technology development, I was appointed assistant secretary general of the United Nations for Science and Technology. In January, I took over as executive director of the United Nations Center for Science and Technology for Development." . . . Two alumni in the department have retired from the Du Pont Co.: **A.C. Masias Y Docarmo**, S.M.'43, in June 1984, after 35 years of service; and **W. Henry Linton**, Sc.D.'49, in May 1985. . . . **Howard Klee, Jr.**, Sc.D.'72, is supervising process design work at Amoco Oil, Chicago, and is also a visiting professor at the University of Michigan, Ann Arbor.

William S. Hutchinson, Jr., S.M.'49, writes, "I'm not one to support the current vogue necessarily, but in the last year I have joined the group that has cancer. Mine is lymphosytic lymphoma. I'm now (November 1985) in my fourth bout with chemotherapy and more than holding my own at 71 years old. I'm aiming, however, to see the next

century. Prior to the first chemotherapy on July 13, 1985, I won a silver medal in a United States Masters Swimming Association open-water long-distance (two miles) national championship swimming meet in Charlottesville, Va.—no wonder I'm still tired." . . . **W. A. Holve**, S.M.'55, writes, "Having formed OPTEC Ltd., Surrey, England, chemical engineering consultants in 1983, I'm pleased to report (in spite of the strong downturn in engineering activity) that several interesting projects were undertaken in 1985. In Holland, assignments were completed on two natural gas dehydration units for Bangladesh. In England, studies for an LPG-condensate terminal to exploit a smaller North Sea field await decision for implementation, and advisory services for engineering improvements to a major French chemical concern continue."

James E. Seebold, Sc.D.'39, of Flossmoor, Ill., a 35-year employee with Standard Oil of Indiana (Amoco) passed away in St. James Medical Center, Chicago Heights, Ill., on October 3, 1985. Seebold was made assistant manager of research at Amoco in 1952 and retired in 1975 as senior consulting engineer.

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XI URBAN STUDIES AND PLANNING

Otis Ginoza, M.C.P.'82, writes that he is "currently living in Los Angeles, working as a senior planner for the Los Angeles Community Design Center. Most of my work involves helping resident organizations in mobile home parks purchase their parks from the owners and run them as cooperatives." . . . M. Todd Cooke, M.C.P.'47, will retire as vice-chairman of the Philadelphia Savings Fund Society in April 1987.

Tomasz Sudra, Ph.D.'72, reports that since 1984 he has been officer in charge of training of the United Nations Center for Human Settlements (HABITAT), Nairobi, Kenya. He explains that Habitat's training programs "cover major regions of the developing world. Their principal subject areas are: urban management planning and finance, project preparation and management, housing policies and programs, community participation, and application of micro-computers in human settlements management and planning." . . . Dietrich Garbrecht, M.C.P.'70, writes that since July 1, 1984 he has been editor-in-chief of *Aktuelles Bauen/Plan*, one of the three leading Swiss architecture and planning journals. The editorial office is located at: Kanzleistr., Postfach, CH-8026, Zurich.

XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Two members of the department at M.I.T. have returned from high adventure in China. They were members of a joint U.S.-China expedition to climb what was then the world's second-highest unclimbed mountain, Ulu Muztag, near the Tibetan border. Professors Burrell C. Burchfiel, a structural geologist, and Peter Molnar, a seismologist, were a day away from reaching the summit when two Chinese members of the group who already had reached the peak fell onto a glacier while returning to camp. Burchfiel and Molnar helped rescue them, but the lost time meant that the U.S. climbers' assault on the peak had to be called off.

"We were at the highest camp, about 21,000 feet, and were going for the peak the next day," Professor Burchfiel recalls. But that disappointment did not spoil an otherwise "exciting" adventure that produced some interesting scientific data—the real reason the two were on the trip. "We discovered some very peculiar types of granite never before found in northern Tibet," Burchfiel said, "and we also located an oceanic suture line where pieces of the continental crust had closed, and some remnants of oceanic rock in between."

Elliot Newman, S.M.'65, is director of marketing at Hart-Crowder, Seattle, Wash., a geotechnical, environmental, and hydrogeologic consulting firm; his job is to manage the firm's national marketing effort in environmental services and hazardous waste management. . . . Robert M. Stesky, Ph.D.'75, is currently associate professor of geology at the Erindale campus of the University of Toronto, engaged in research on the physical and mechanical properties of rocks. . . . Glenn D. Roe, Ph.D.'65, reports his latest activities: "Retired from ARCO in August 1985; teaching geology at Plano (Tex.) Senior High School; sailed my boat to the Bahamas for the third time last summer, spending three weeks in the islands; and still playing league tennis (game still improving)."

XIII OCEAN ENGINEERING

James H. Webber, N.A.'55, has been promoted to vice-admiral in the U.S. Navy and assigned as the Navy's chief engineer to the Naval Sea Systems Command (NAVSEA), Department of the Navy, Washington, D.C. Webber's duties include the maintenance of the technical engineering excellence throughout NAVSEA and service as principal

advisor on engineering matters to the NAVSEA commander. . . . Peter Tarpgaard, Ph.D.'70, reports, "I have left my position as principal analyst in the National Security Division of the Congressional Budget Office to accept a new job as manager of submarine programs with the Charles Stark Draper Laboratory, Cambridge."

Jacques B. Hadler, S.M.'47, is currently dean and professor of naval architecture at Webb Institute of Naval Architecture, Glen Cove, N.Y. . . . A cryptic report from Keating Keays, N.E.'55: "Living on the Eastern Shore, Maryland; doing some private consulting and working as a systems analyst with Computerware Corp. We miss the Boston area but not in the winter." . . . William N. Price, S.M.'41, writes from Washington, D.C., that he is "working full-time, pro bono, for a class of disadvantaged people for whom little is being specifically done—people who are mentally normal but severely physically handicapped."

XIV ECONOMICS

Professor Martin L. Weitzman, Ph.D.'67, of M.I.T. now holds the Institute's Mitsui Professorship in Problems of Contemporary Technology, a chair made possible by a gift of the Mitsui Group of Japanese companies. Weitzman is best known for his 1984 book, *The Share Economy*, advocating profit-sharing as a way to improve U.S. corporate performance. He's also written on microtheory, comparative economic systems, Soviet economics, economic development, and energy economics.

Professor Emeritus Charles P. Kindleberger of M.I.T. is the author of *Keynesianism vs. Monetarism and Other Essays in Financial History* (Allen and Unwin, 1985)—a collection that together summarizes the financial history of the international economy during the past 200 years. Reviewing Kindleberger's book in the *Wall Street Journal*, David Laidler, professor of economics at the University of Western Ontario, finds it "a marvelous book for dipping into," with "much instruction and amusement."

Russell T. Roth, Ph.D.'81, an assistant professor of economics at the U.S. Air Force Academy, Colorado Springs, has been promoted to major in the U.S. Air Force. . . . Lawrence E. Hilibrand, S.M.'80, has been named a director of Salomon Brothers, Inc., New York City. Hilibrand joined the firm in 1980 as a specialist in interest rates futures and options and in 1981 was named a vice-president. . . . Herman O. Stekler, Ph.D.'59, is currently professor of economics, Industrial College of the Armed Forces, National Defense University, Ft. McNair, Washington, D.C.

XV MANAGEMENT

Jennifer Greenspan, S.M.'83, writes, "New job and new home: bought a house in Bedford, Mass., in July; left Apollo for General Computer Co. in September—new position is manager of management information systems. Thrilled with both changes." . . . Jon E. Einsidler, S.M.'74, has started up a corporate finance department for C.L. Glazer and Co., an investment bank in Greenwich, Conn. . . . Herbert S. Ward, S.M.'49, retired from IBM on March 31, 1982, after thirty years and two months of service and has been elected councilman in the town of Pound Ridge, N.Y. . . . Edward K. Dahill, S.M.'77, former vice-president, finance, has been promoted to senior vice-president at Iomega Corp., Ogden, Utah.

Bruce Blumberg, S.M.'81, writes, "I left Apple Computer, Inc., after four years there to join Steve Job's new company, Next, Inc. At Apple I was part of the original marketing team for Lisa. However, my major contribution was the development and introduction of the Laserwriter for which I was responsible. Janie and I are expecting our first kiddo in April!" . . . Raymond J. Epich, S.M.'54, became vice-president and manager of

the new Chicago office of the Diebold Group, Inc., in August 1985. . . . **Stanley J. Dorst**, S.M.'52, writes, "I have taken a new position as president of Grosvenor Development Corp. in San Francisco. Also, I have been elected chairman of the board of the California Business Properties Association and to the Executive Committee of the International Urban Development Association with headquarters in Holland."

John D. Proctor, S.M.'73, former executive vice-president of the Stanley M. Proctor Co., Twinsburg, Ohio, has been named president and chief executive officer of the privately held company, responsible for its daily operation. His father, **Stanley M. Proctor**, '43, who founded the company in 1955, is chairman of the board. . . . **Lucille D. Roseman**, S.M.'72, of Lexington, Mass., passed away on November 17, 1985; no further details are available.

Sloan Fellows

Christopher B. Roberts, S.M.'85, director of the venture financing for the Center for Space Policy, Cambridge, Md., was one of the two recipients of the Space Foundation's National Excellence Recognition Award last November. Roberts was cited for his outstanding graduate research culminating in his thesis—"Financing Commercial Ventures in Space." . . . **Edward Steinhoff**, S.M.'71, employed with Dow Corning Corp., Midland, Mich., since 1956, has been named vice-president for finance and chief financial officer, responsible for directing all major financial activities. Steinhoff's previous assignments have included area manager for Latin America, director of personnel and communications, and director of manufacturing and engineering.

Denis B. Trelewicz, S.M.'70, is chief financial officer of Dynatrend, Inc., Woburn, Mass. . . . **James F. Walsh**, S.M.'56, reports that he retired on July 1, 1985, and is spending his time on travel, hobbies, and with his three children and six grandchildren. . . . **Joseph W. James**, S.M.'64, executive vice-president of Household International, Inc., has been elected a director of Mack Trucks, Inc., Allentown, Penn. . . . **Richard J. Santagati**, S.M.'79, resigned, effective December 15, 1985, as chairman and president of NY-NEX Business Information Systems, New York City, "to pursue new career opportunities."

Award from M.I.T. (1983).

Management of Technology Program

Jacalyn got a call from **John Hallal**, S.M.'85, in December. He has been unbelievably busy at RCA since his return, we've been hearing through the grapevine. The company sent him to an intensive course this fall in software management, and he travels quite a bit to California. John went to the Boston area "M.I.T. Class of '84" luncheon organized this summer by **Gene Huang**, S.M.'85 and saw **Drew Peck**, S.M.'85. Drew indicated he could be enjoying his job with Gartner Group more but will give it some more time. John told Jacalyn that he would organize the next luncheon.

We heard from **John Kindinger**, S.M.'85, and his wife, Cindy, via a nice letter over the holidays. John seems to be enjoying his position with Pickard, Lowe, and Garrick in Newport Beach, except for the fact the family hasn't yet had a chance to find a house in California. Since John's first assignment was with the Seabrook (N.H.) nuclear plant, Cindy and Jennifer have remained in Michigan where John joins them every weekend. The plan was to start looking in California come January. Meanwhile, Cindy has kept up her job teaching sixth graders, and Jennifer has been very busy with Brownies, the church youth club, etc. We hope that by the time this note is published, you're all happily ensconced together in Newport Beach.

We got a nice Christmas card and letter from **Roz and John Krawiec**, S.M.'85, reporting that things were going very well in "snowbound Utah." John claimed his job at Morton Thiokol gets busier and busier, but not yet as busy as the

MOT summer term! They saw **Rick Orr**, S.M.'85, who came to visit while interviewing at Morton Thiokol! According to John, Rick's company, Dyna-Drill (Calif.), may be falling on some hard times, and Rick has been looking around. John hopes, of course, Rick and Sallee will decide to settle in Utah, too.

Kuni Oka, S.M.'85, was in touch with Jacalyn in December. He's very busy at Yoshitomi Pharmaceuticals, Fukuoka, Japan, working hard to come up with "new, profitable products" and experimenting with "antibiotics intermediates." He remembers very fondly his life in Boston and M.I.T. . . . Jane ran into **Enrico Poggio's** (S.M.'85) wife, Pilar, in a shopping mall in January. Pilar said Enrico is extremely busy at Nichols Engineering. But at least they've been able to remain here in Boston. (One position Enrico had been considering would have meant moving to Italy, and Pilar sounded a bit relieved that this plan had fallen through.) Jane asked Pilar to urge Enrico to try to plan his June travel so they could come to the MOT reunion dinner on June 6.

Charles Bow, S.M.'84, called Jane Morse in December, and they had a long chat about his new position. Charles left Pilkington's Barr and Stroud this fall to join Sangamo Controls, Glasgow, as engineering manager. Sangamo is a subsidiary of Schlumberger, and Charles' position actually translates into "vice-president of engineering" with an additional marketing role. The position will give him both line and executive experience, Charles says. Charles and his new bride, Alison, are thoroughly enjoying their married life. Alison is an ophthalmologist and moved from Dundee. Charles says he does manage to travel to the Boston area occasionally on business and hopes to be able to visit M.I.T. sometime soon.

Bernard Cerles, S.M.'85, wrote **Ed Roberts**, '57, a nice note in December, describing his position back at Rhône Poulenc as Process Department manager in the Silicon Division. He says he has lots of opportunity to put into practice what he learned in his year at M.I.T.—marketing/technology interface, communication in research labs, etc.—and is enjoying his new responsibilities.

Alan Drane, S.M.'85, surprised Jacalyn Walker-Sharp by stopping by at the Program Office last January 16. Jacalyn says he looked wonderful and seemed to be very happy with his position at Combustion Engineering. He looked up **Anita Kirkpatrick**, S.M.'85, and **Rick Orr**, S.M.'85. Alan does get to Boston occasionally as Combustion Engineering has a high energy laser lab in Somerville. (The hardest part in stopping by to see us is parking, he says!) Alan is looking forward to seeing all the MOT's at the reunion dinner in June. . . . **Bruce Gobiuff's** (S.M.'84) wife, Sharon, wrote to Jane over the holidays. Bruce is now with IBM's Federal Systems Division working on airline projects. Sharon reports he travels a lot to Tulsa and Chicago. Sharon is working as an instructional aide for the Montgomery County Public Schools and will pursue her teaching degree. The boys, Howie and Neil, are doing splendidly in school, and it sounds like they're headed toward careers in the space program.

XVI AERONAUTICS AND ASTRONAUTICS

Professor **Sheila E. Widnall**, '60, will be president-elect of the American Association for the Advancement of Science on May 31, 1986, when the AAAS ends its annual meeting in Philadelphia. When she becomes president for 1987-88, Widnall will be the fifth woman and only the fourth engineer to lead the AAAS in its 137-year history. She was the first alumna on the M.I.T. engineering faculty when she was named assistant professor 21 years ago.

Four members of the M.I.T. community are now studying the cause of the explosion of the space shuttle *Challenger* as members of the commission appointed by President Reagan. The four: **Eugene E. Covert**, Ph.D.'58, head of the depart-



Cisneros: No Better Role Than Mayor

Why face the headaches and heartaches of being mayor of a major American city?

Because, says **Henry Cisneros**, '74, mayor of San Antonio, "I don't know of any higher office than serving as mayor of one's own city."

"City government has more to do with the quality of daily life in America than any other level of government," Cisneros told a conference for newly elected mayors at Harvard's Kennedy School of Government last winter.

Indeed, Cisneros told the new mayors, "you have been elected to a position that exists everywhere in this world. In every nation, whether it be a socialist country, a centrally planned country, a democratic country, a totalitarian country—in villages or in metropolitan areas—each one has a mayor."

The conference was co-sponsored by the U.S. Conference of Mayors and Harvard's Institute of Politics. A visiting fellow at the IOP, Cisneros was keynoter for a five-day program that offered workshops on budget and financial issues, office organization, personnel selection, media relations, and management of political constituencies.

Cisneros, elected in 1981 as San Antonio's first Hispanic mayor, offered advice to the new leaders based on his own experiences. "Keep in mind that as the mayor you have more control of the timing of initiatives—the pace of your life. People who wouldn't pay attention to you before do now. It's possible to call a meeting with only 48 hours' notice and have people show up," Cisneros said.

Cisneros also encouraged the new leaders to use a grassroots approach to understanding city problems. Grappling with city problems in the last four years has spurred Cisneros to ride in ambulances, garbage trucks, taxicabs, and police cars on his off hours. □

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ment at M.I.T.; **Richard P. Feynman**, '39, professor of physics at Caltech; Major General **Donald J. Kutyna**, S.M.'65, director of space systems and command, control, and communications for the U.S. Air Force; and **Albert D. Wheelon**, Ph.D.'52, senior vice-president of Hughes Aircraft Co. Cover has been a consultant on rocket engines for NASA, and he was chairman of a review committee on the design of the shuttle's main engine in the late 1970s. . . . **Marc L. Sabin**, Sc.D.'73, writes, "I retired from the Air Force effective August 1, 1985. My present position is technical assistant to the vice-president for strategic electronic warfare at the Eaton Corp. AIL Division and living in Northport on Long Island, N.Y." . . . **Kuang-Fu Ku**, S.M.'36, writes from Taipei, Taiwan: "After graduating from M.I.T., I worked in the United States and other places for three years to gain experience. I was in the Chinese Air Force for 30 years, working in the field of R&D, retiring with the rank of lieutenant general. In the last 16 years, I worked for the Ministry of Economic Affairs (MOEA) and then the Industrial Technology Research Institute (ITRI) as an executive vice-president; in September 1985 I became a senior advisor. ITRI, a bridge between academic institutions and industry, has as its broad objective assisting local industry in technology innovation, improvement of productivity, and effective utilization of resources so that domestic industry can flourish in high-technology areas. I have been very fortunate to have worked for nearly 50 years in a free environment with the knowledge I gained at M.I.T."

Air Force Captain **Randall K. Liefer**, S.M.'82, has been decorated with the Meritorious Service Medal for outstanding non-combat meritorious achievement or service to the United States. Liefer is an aeronautics instructor at the U.S. Air Force Academy. . . . **Dominick Bruno**, E.A.A.'81, was married in July 1984 to the former Helen McEntee and they were expecting their first child in November. Bruno is working for RCA Astro-Electronics, East Windsor, N.J. . . . **James W. Neighbours**, '41, writes, "After retiring from three different careers, my wife and I are enjoying the good life on Southampton, Long Island, N.Y., and travel considerably. First career was 21 years in the U.S. Navy as aeronautical engineer and aviator; then 10 years in manufacturing (plant manager for Grumman); and recently 11 years with Eastern Air Lines. Currently enjoying being a member of the Educational Council for M.I.T., interviewing potential students from Eastern Suffolk County."

Hugh Flomenhoft, S.M.'47, reports from Lexington, Mass., "I am still active in the American Institute of Aeronautics and Astronautics and recently received my 40-year pin. I organized a lecture series for able high school students last spring as part of the Boston Museum of Science Cabot Lectures, and plan to repeat it next spring. The subject is 'The Role of Computer Simulation in Aerospace Engineering.' I am also still an active member of the New England Masters Swim Club and manage to stay in the top ten of my age group (60-64)." . . . **Robert D. Fletcher**, Sc.D.'41, of Tubac, Ariz., passed away on October 27, 1985; no further details are available.

XVII POLITICAL SCIENCE

The Japan Society of Information and Communication Research has posthumously awarded Professor **Ithiel D. Pool** of M.I.T. its 1985 World Communication Prize "in appreciation of his devoted and distinguished services for the advancement of communication in the world."

Professor **Richard J. Samuels**, Ph.D.'80, who was instrumental in organizing and now heads the M.I.T.-Japan Science and Technology Program, is the new editor of a newsletter—on freshwater fishing, of all things. After enjoying fishing in a casual way much of his life, he called the Massachusetts Division of Fisheries and Wildlife several years ago to find out how he could learn



The prestigious International Academy of Aeronautics has two new members David G. Hoag, '46 (left), head of advanced systems at the Charles Stark Draper Laboratory, Inc., and Robert Duffy (right), president of the laboratory. Above, they receive congratulations from one of the academy's oldest members, Professor Emeritus Charles S. Draper, '26.

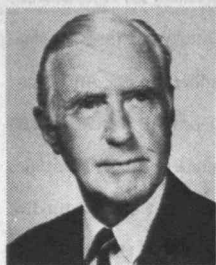
more about the sport. That plugged him into a program called "Urban Anglers," and recently Professor Samuels took over the program's "Short Casts" newsletter and his eight-year-old son Brad, "who likes to draw" and is also an ardent fisherman, became the "staff artist." What's their favorite fishing spot? "We like to go out in our small canoe for bass, trout, and the like on the Sudbury River," Professor Samuels said, adding that the river yields "a lot of different fish."

"The Potential Economy of the Middle East" is the subject of a new M.I.T.-Harvard seminar series inaugurated this spring by Professors Nazli Choucri of M.I.T. and Don Babai of Harvard. Choucri describes it as "the first academic forum on the Middle East in the Boston area to be devoted exclusively to developmental issues, and more generally, to questions that lie at the intersection of politics and economics." There will be six sessions per term for at least the next several years, says Choucri, and the schedule can be obtained from her office—(617) 253-6198.

Ernest H. Evans, Ph.D.'77, is teaching in the Department of Government at Georgetown University. . . . **Alma H. Young**, Ph.D.'78, associate professor and associate director of the University of New Orleans School of Urban and Regional Studies, has been appointed associate vice-chancellor for academic affairs of the university. Young has been at SURS since 1976 and was its acting director in 1984; she was special assistant to the mayor of New Orleans for federal resource utilization from 1978 to 1980.

XVIII MATHEMATICS

Harold G. Ingraham, Jr., '49, senior vice-president of New England Mutual Life Insurance Co., Boston, was named president-elect of the Society of Actuaries at its 1985 annual meeting. Ingraham will serve in this position for one year and assume the presidency for 1987. At New England Mutual Life he is responsible for business insurance and pension program development and marketing. . . . **Jan L. Boal**, Ph.D.'59, who is associated with the Department of Mathematics at Georgia State University, Atlanta, writes from Senoia, Ga., "My wife and I have purchased a small hotel built in 1907 which we hope to restore as a bed-and-breakfast inn."



J. J. Wilson

John J. Wilson, 1907-1985: Alumni Leader of Many Interests

As secretary of the M.I.T. Corporation, John J. Wilson, '29, personally signed 45,000 M.I.T. degrees between 1959 and 1979—probably more than other officer of the Institute in its 125-year history. As an avid sailor, he made five transatlantic voyages, taking his 42-foot ketch to the Baltic, the Mediterranean, and the west coast of Africa as well as the Caribbean, where he maintained a second home in Barbados. As an enthusiastic figure skater he was president of the Skating Club of Boston. He was an active trustee of the Museum of Fine Arts and an overseer of the Boston Symphony Orchestra.

In the world of business Wilson was known as founder of a successful start-up, Doelcam Corp., later acquired by Minneapolis Honeywell, of which Wilson became vice-president. He was president of Honeywell's Datamatic subsidiary from 1955 to 1964.

And when Mr. Wilson died at his Marblehead home on December 31, 1985, David S. Saxon, '41, described his career as "a unique example of service and devotion to M.I.T."

Wilson first joined the M.I.T. Corporation as an ex-officio member when he was elected president of the Alumni Association in 1958. A year later he was made secretary of the Corporation, and in 1962 he became a life member. During the next 20 years before his retirement in 1979, when he was made honorary secretary, Wilson had an active role in the management of M.I.T., a consultant to five presidents. From 1960 to 1963 he was general chairman of M.I.T.'s Second Century Fund, a \$66-million capital program that ultimately raised \$100 million. Included in these totals were funds from Mr. and Mrs. Wilson for the John and Dorothy Wilson Professorship in Biochemistry.

Before founding Doelcam Corp. in 1946, Wilson was general purchasing agent for Sperry Gyroscope during World War II. He held bachelor's and master's (1930) degrees in business and



M. Finston



A. L. Hesselschwerdt

engineering administration, and following graduation he worked with Crucible Steel, the Waltham Watch Co., and the Terrell Machine Co.

Morton Finston, 1920-1986: Aerodynamics and Heat Transfer Specialist

Morton Finston, professor of aeronautics and astronautics, emeritus, a member of the faculty for 33 years, died on January 2 of cancer at Massachusetts General Hospital. He was 66.

Finston came to M.I.T. in 1949, having completed his Ph.D. in applied mathematics at Brown; earlier he had studied at Northwestern (B.S. 1941), Harvard, and Caltech. His first M.I.T. assignment was in applied mechanics and aerodynamics, and he later became director of the Naval Supersonic Laboratory. (That laboratory was renamed the Aerophysics Laboratory.) He retired in 1984.

Finston's special field was viscous fluid flows relating to aerodynamics, aircraft drag, and heat transfer. He also worked with Professor Emeritus C. Stark Draper, '26, on the design of high-precision inertial gyroscopes.

August L. Hesselschwerdt, 1909-1986: Honored for Work in Refrigeration

A 50-year member of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Professor Emeritus August L. Hesselschwerdt, '31, died at his home after a long illness on January 17; he was 75.

Hesselschwerdt joined the M.I.T. faculty in 1942, teaching at the Institute until his retirement in 1975; since then he had remained a consultant to the M.I.T. physical plant department in the field of refrigeration and air conditioning.

Following completion of his master's degree (1934) at M.I.T. in mechanical engineering, Hesselschwerdt worked at York Ice Machinery Corp. and taught at Wayne State University; he had also lectured at Harvard, the University of Beirut, and the International Institute of

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Refrigeration at Turin, Italy. He held the ASHRAE distinguished service award (1969) and was formerly a national director of the society.

Gary David Romano, 1965-1986

Gary David Romano, '86, whose major was in electrical engineering, died on November 24 from multiple injuries in a car accident in Malden, Mass. He was 21.

A member of Sigma Alpha Epsilon, Romano was described by his fraternity brothers as being "very friendly, very funny, very happy . . . a leadership figure, a lot looked up to" in the house. Professor Jeffrey H. Lang, '75, Romano's adviser, was enthusiastic about his broad interests in all phases of electrical engineering.

George M. Bunker, 1908-1985

George M. Bunker, '31, retired chairman of Martin Marietta Corp., died on November 5, 1985, at his home in Washington, D.C. He was 77.

Bunker studied mechanical engineering at M.I.T. At the age of 44 he became president of the Glenn L. Martin Co., which he built into the billion-dollar-a-year Martin Marietta Corp. before retiring 25 years later, in 1977. He is best remembered at M.I.T. as an active member of the leadership committee for the Leadership Campaign from 1976 to 1980 and—during the same period—a member of the Visiting Committee on Aeronautics and Astronautics.

Herbert R. Stewart, 1903-1986

Herbert R. Stewart, '24, retired chief electrical engineer of the New England Electric System, died suddenly at his home on January 6. He was 83.

Stewart was a specialist in high-voltage transmission systems, and he was involved in overall design and operation of the New England power supply network from 1930 until his retirement in 1972. He held the Habirshaw Medal of IEEE (1974) and was the Engineering Societies of New England "engineer of the year" in 1975. A familiar figure in many M.I.T. Alumni Association activities, Stewart was executive vice-president of his class and a life member of the Alumni Council.

Deceased

The following deaths have been reported to the Alumni Association since the Review's last deadline:

Phillips N. Brooks, '16; March 3, 1978; Stratham, N.H.

Nathaniel Warshaw, '16; December 14, 1985; Sarasota, Fla.

Jesse A. Rogers, Jr., '17; December 13, 1985; Boston, Mass.

Charles S. Venable, '17; October 4, 1984; Doylestown, Penn.

Paul McAllister, '18; December 4, 1985; Anderson, Ind.

Henry B. Blumberg, '19; December 28, 1985; Tuckahoe, N.Y.

Robert E. Travis, '21; November 6, 1985; Hinsdale, Ill.

Harold N. Loomer, '22; December 1985; Dunedin, Fla.

Jacob A. Elfenbein, '23; November 15, 1985; Monterey, Calif.

Richard M. Watt, Jr., '23; December 19, 1985.

Herbert R. Stewart, '24; January 6, 1986; Waban, Mass.

Constantine L. Zakhartchenko, '25; September 30, 1985; Washington, D.C.

Joseph C. Manian, '26; December 26, 1985; New York, N.Y.

Cyrus A.W. Grierson, '27; September 1985.

Arthur M. Hill, '27; December 17, 1985; Pacifica, Calif.

George E. Bagby, '28; October 23, 1985; Huntington, W.Va.

E. Vernon Lewis, '28; November 29, 1985; Collegeville, Penn.

John H. Butler, '29; December 17, 1985; Columbus, Ohio.

Edward McAnahan Tittman, '29; October 10, 1985; Reno, Nev.

John J. Wilson, '29; December 31, 1985; Boston, Mass.

Carl F. Baker, '31; December 16, 1986; Hendersonville, N.C.

Mrs. Francis C. Crotty, '31; May 20, 1984; Arlington, Va.

A. L. Hesselschwerdt, Jr., '31; January 17, 1986; Milton, Mass.

Herbert S. Hiller, '31; October 31, 1985; Verona, N.J.

Harry Soden, '31; January 4, 1986; Rocky Mount, N.C.

Draveaux W. Bender, '33; January 18, 1986; Cambridge, Mass.

Harold A. Butters, Jr., '34; June 30, 1985; Winchester, Mass.

Betsy D. Weeks, '34; February 13, 1985; Fort Smith, Ariz.

Theodore A. Earl, '35; June 22, 1985; Winter Harbor, Maine.

Malcolm A. Porter, '35; December 28, 1985; Hagerstown, Md.

George Bowditch Hunter, Jr., '37; June 1985; Clearwater, Fla.

Thomas B. Akin, Jr., '39; November 3, 1985; Fairfax, Va.

Wayne J. Holman, Jr., '39; December 27, 1985; Plainfield, N.J.

Edward M. Usher, '39; January 13, 1986; South Chatham, Mass.

Frank H. Hall, Jr., '42; August 30, 1985; Hilton Head Island, S.C.

James M. Smith, Jr., '46; December 27, 1985; Spartanburg, S.C.

Henry D. Ward, Jr., '46; January 26, 1986; Cockeysville, Md.

Leon A. LaFreniere, '48; January 16, 1986; Reading, Mass.

Robert A. Miller, '48; April 16, 1985; Sarasota, Fla.

Violet B. Haas, '49; January 21, 1986; West Lafayette, Ind.

George Inada, '54; April 24, 1985; Bethesda, Md.

Herbert R. Fortgang, '57; November 5, 1985; Van Nuys, Calif.

Mitchell H. Dittmann, '59; December 1, 1985; Roswell, Ga.

John F. Probst, '61; December 9, 1980; Mishawauka, Ind.

Frank L. Williams, '74; July 11, 1983; Beaumont, Tex.

Ronald E. McNair, '77; January 28, 1986; Seabrook, Tex.

Bruce A. Martin, '81; June 25, 1985; Berkley, Mich.

How to Solve Tokyo's Parking Problem

Matthew Fountain reports that the historical journal he and his wife edit has been well received. Over 100 new members have joined their historical society to obtain the journal, and a newspaper reporter is writing a story on it.

Our supply of computer-related problems is running low, and speed problems are in critically short supply. So keep those cards and letters coming!

Finally, I would like to dedicate this column to the seven shuttle astronauts killed while trying to advance our understanding of science and nature and to their families (including their large NASA family).

Problems

APR 1. We begin with a computer-related problem from Harry Zaremba:

Frequently it is useful to know what the date and date-of-week will be after a certain number of days will have elapsed. When the number of days is large, use of a calendar to establish the date is a bit awkward, and a calendar may be of little help when it is found that the required date falls into the range of a different year. For example, a convicted felon who is sentenced to the "pen" for 300 days after December 5, 1985, may be interested to know that his last day of imprisonment will be Wednesday, October 1, 1986. The problem therefore is to develop a program that determines the date and day-of-the-week for any Nth day after a selected date.

APR 2. Frank Rubin wants to introduce some friends of his, the family of functions

$$f_n(x) = \int_{t=0}^x \sin(t^n) dt$$

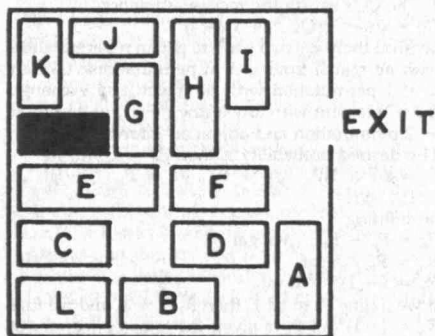
The infant f_1 is reasonably well behaved; it is bounded and oscillates between -1 and $+1$. How well behaved are the other family members, f_2, f_3 , etc.?

APR 3. Emmet Duffy wants you to arrange the digits 1 through 9 into two proper fractions and two positive integers

so that the four numbers total 100. One such arrangement is $1/8, 63/72, 94$, and 5. Find seven others. The result of interchanging digits in the integers is not considered a different arrangement—e.g., $1/8, 63/72, 95$, and 4 is considered the same as our original arrangement.

APR 4. An urban problem from Nob Yoshigahara.

The following is a parking area found in Japan. Your car is black. You want to go out. Because so many cars are packed in, many have to be moved before yours is free. In fact, so many cars are packed in that they can move only back and forth and cannot turn. How many moves do you need to get out from here? The fewer moves, the better.



APR 5. P.V. Heftler wants you to find the smallest number that can be partitioned into four distinct positive integers such that the sum of every pair is a perfect square.

Speed Department

SD 1. Phelps Meaker, whose eyes are 62 inches above the ground, notes that the floor of the aisles in his favorite supermarket is glossy linoleum and reflects the fluorescent lamps 10 feet above, spaced 6 feet apart and installed crosswise of the aisle. As he moves down the aisle at a uniform rate of 42 inches per second, the reflected images move as well. How often does he catch up with an image?

SD 2. Jim Landau asks for the significance of the sequence of numbers 2, 5, 5, 4, 5, 6, 3, 7, 6.

Solutions

N/D 1. Given the coordinates of four points, determine if they form the four corners of a square. No assumption can be made about the order in which the points are presented.

Jim Landau found a typographical error in the problem; in order to form a square, the third point must be (7,4), not (2,4). But he conquered this hazard to send us a sweet solution designed for both human and machine consumption. He describes the problem as "a piece of cake, or more exactly a batch of cookies. In a previous office, where we did much map reading, we called this problem the 'cookie cutter' because once we had specified the four points, we had cut out a quadrilateral from the rest of the map, just like cutting out a cookie from a sheet of cookie dough. It was interesting that, while it was not difficult to read four sets of coordinates from a map, it proved surprisingly difficult to read the four points in clockwise sequence, northwesternmost point first. Therefore we had to develop an algorithm to take four points in any order and try to make a convex quadrilateral out of them." Landau says there are a number of ways to solve the problem, based on various geometrical theorems. He thinks the following is the simplest:

A quadrilateral is a convex quadrilateral and in fact a rhombus if all four vertices are distinct and all four sides are equal. A rhombus is a square if both diagonals are equal.

Proof: Consider 3 points A, B, and C with $AB = BC \neq 0$. Construct a pair of circles with centers A and C and with radii $= AB$. The circles will intersect in two points, B and a new point which we will call D. (If A, B, and C are collinear then points B and D will be the same.) Also A, B, C, and D are coplanar and $CD = AD = AB = BC$.

If B and D are distinct points then they are on opposite sides of the line AC. If A and C are distinct points then they are on opposite sides of the line BD. Hence the quadrilateral ABCD is convex if A, B, C, and D are all distinct.

Triangles CBD and ADB are congruent because all three pairs of corresponding sides are equal. Hence angle CBD = angle ADB which means BC and AD are parallel. Similarly AB is parallel to DC. Hence ABCD is a parallelogram and, since all four sides are equal, a rhombus.

If the diagonals BD and AC are equal, then triangles ABD, CBD, BAC, and DAC are all congruent



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012.

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(because all three pairs of corresponding sides are equal); hence angle ABD = angle DAC, angle CBD = angle BAC, and by summing, angle BAD = angle ABC. By similar arguments, angle BAD = angle ADC = angle DCB, so all four vertex angles of the rhombus are equal. Since the angles of a quadrilateral add up to 360 degrees, then each vertex is 90 degrees and ABCD, with four equal sides and four right angles, is by definition a square, QED.

The algorithm is as follows: Given four coplanar points W, X, Y, and Z (not necessarily distinct), if $WX = XY = YZ = ZW \neq 0$ and $WY = XZ \neq 0$, then WXYZ is a square; or if $WX = XZ = ZY = YW \neq 0$ and $WZ = XY \neq 0$, then WXZY is a square; or if $WY = YX = XZ = ZW \neq 0$ and $WX = YZ \neq 0$, then WXYZ is a square; or the four points do not form a square.

A human-friendly version of the algorithm is as follows: given four distinct coplanar points, form the six sets of distances between the points. If four of these distances are the same and the remaining two distances are also equal but not the same as the first four, then the four points form a square with the two line segments with the second set (the pair) of equal lengths being the diagonals.

Also solved by Bard Crawford, Brian Leibowitz, Chester Claff, Christopher Leavitt, F. G. Bartlett, Harry Zaremba, Howard Stern, Joseph Keilin, Mary Lindenberg, Matthew Fountain, Michael Hennessey, Richard Heldenfels, Richard Hess, Richard Marks, Samuel Levitin, Steve Feldman, and Winslow Hartford.

N/D 2. For an office party, each person is supposed to bring a gift for someone else. The recipients are assigned to givers by writing each person's name on a slip of paper, putting the slips in a hat, and having everyone draw a slip. What is the probability that in an office of n people, no one draws his own name?

The proposer, Oren Cheyette, sent us the following solution, which he attributes to Vëit Elser. Let Q_n denote the number of ways a successful (no match) draw can be performed by a group of n people. For low n , we have $Q_1 = 0$, $Q_2 = 1$, $Q_3 = 2$. The Q_n 's satisfy the recursion relation

$$Q_n = (n-1)(Q_{n-1} + Q_{n-2})$$

because there are two ways to get an n -permutation with no match from $m < n$ permutations: take an $n-1$ permutation with no match and exchange the n th element with any of the $n-1$, or take an $n-2$ permutation and adjoin an interchanged pair. The desired probability is then $P_n = Q_n/n!$, so

$$P_n = (n-1)P_{n-1}/n + P_{n-2}/n = P_{n-1} - (P_{n-1} - P_{n-2})/n,$$

$$\text{or defining}$$

$$R_n = P_n - P_{n-1}, \text{ we get}$$

$$R_n = R_{n-1}/n \text{ or}$$

$$R_n = (-1)^{n-1}/n!$$

If we define P_0 to be 1, then $R_1 = -1$, and we find $R_n = (-1)^n/n!$. P_n is given the telescoping sum of R_k :

$$P_n = \sum_{k=1}^n R_k + P_0$$

or, finally, the desired probability is

$$P_n = \sum_{k=0}^n (-1)^k/k!$$

Harry Zaremba applied a sneaky inclusion-exclusion argument to produce a shorter solution: Since the events, "at least one person has selected his own name out of the hat," are not necessarily mutually exclusive, the probability of their occurrence is given by:

$$P = \binom{n}{1} (n-1)!/n! - \binom{n}{2} (n-2)!/n! +$$

$$\binom{n}{3} (n-3)!/n! - \dots + (-1)^{n+1}/n!,$$

or,

$$P = 1 - 1/2! + 1/3! - \dots + (-1)^{n+1}/n!.$$

If Q is the probability of the event "no person draws his own name out of the hat," then,

$$Q = 1 - P \text{ or}$$

$$Q = 1 - [1 - 1/2! + 1/3! - \dots + (-1)^{n+1}/n!] = \sum_{i=0}^n (-1)^i/i!$$

when the number of people n equals 6 or more, then the probability Q for all practical purposes equals e^{-1} or 0.368. Thus, Q is essentially independent of n for $n > 6$.

Mr. Cheyette reports that he has recently seen a variant of this problem in Polya's books on problems in analysis, where the solution was credited to Euler. Richard Hess notes that this problem is discussed in Ball's *Mathematical Recreations and Essays*, where it is traced to DeMontmorts in 1713.

Also solved by Avi Ornstein, Bin Ly, Edwin McMillan, Gerald Leibowitz, Harry Zaremba, Joseph Keilin, Mark Clements, Mary Lindenberg, Matthew Fountain, Michael Tamada, Pierre Heftler, Richard Hess, Roger Milkman, Steve Feldman, T.J.H. (no name was given), Raymond Gaillard, and Winslow Hartford.

N/D 3. Given a square matrix A (not necessarily invertible) satisfying $AA' = AA'$, where the prime signifies transpose operator, show that $A = A'$ using matrix operation only, i.e. without using normed algebras and approximating A by an invertible matrix.

The proposer Howard Stern offers the following: We make use of the fact that if $BB' = 0$ then $B = 0$. That is easy to prove using the trace operator of a matrix.

Let $D = A - A'$. It is sufficient to prove that $DD' = 0$.

$$DD' = (A - A')(A' - A) = AA' - AA - A'A' + A'A = 0 - AA' + A'A \text{ (using the given and that } A'A' = AA')$$

$$= A'A - AA.$$

Let $B = DD' = A'A - AA$. Now it is sufficient to prove $BB' = 0$.

$$BB' = (A'A - AA')(A'A - AA') = A'AA'A - A'AAA' - AA'A'A + AA'AA' = A'AAA - A'AAA - AAA'A + AAAA \text{ (using the given)}$$

$$= 0 - AAAA + AAAA \text{ (using the given)}$$

$$= 0.$$

Therefore, $A = A'$. QED.

Also solved by Michael Tamada and Richard Hess.

N/D 4. What is the lowest number of current U.S. coins (1 cent through \$1) for which there is no combination of coins that will equal in value a single coin? How many such quantities are there under 100?

The following solution is from Phelps Meaker, using the conventions P = penny, N = nickel, D = dime, Q = quarter, H = half-dollar, and $\$$ = dollar:

1 P	31 25P+5N+H
2 2N	32 25P+5N+2Q
3 N+2D	33 25P+N+7D
4 N+2D+Q	34 30P+4N
5 3N+D+Q	35 20P+14N+D
6 5N+Q	36 20P+16N
7 5P+2D	37 30P+7D
8 6N+2D	38 35P+3N
9 8N+D	39 35P+3N+H
10 10N	40 35P+3N+2Q
11 2N+9D	41 40P+D
12 4N+8D	42 40P+2N
13 3N+10P	43 40P+2N+H
14 10P+4D	44 40P+2N+2Q
15 10P+3N+Q+H	45 35P+7N+3D
16 15N+Q	46 40P+6D
17 14N+3D	47 45P+N+H
18 16N+2D	48 40P+7N+Q
19 10P+8N+H	49 45P+3D+Q
20 20N	50 50P
21 20P+N	51 50P+H
22 10P+9N+2D+Q	52 50P+2Q
23 10P+8N+5D	53 45P+5N+3D
24 5P+19N	54 45P+7N+2D
25 25P	55 50P+5D
26 20P+6N	56 50P+2N+4D
27 15P+10N+D+Q	57 50P+4N+3D
28 25P+3Q	58 50P+6N+2D
29 25P+3N+D	59 50P+8N+D
30 25P+5N	60 50P+10N

61 55P+3N+3D
62 55P+5N+2D
63 55P+7N+D
64 55P+9N
65 60P+2N+3D
66 60P+4N+2D
67 60P+6N+D
68 60P+8N
69 65P+N+3D
70 65P+3N+2D
71 65P+5N+D
72 65P+7N
73 70P+3D
74 70P+2N+2D
75 70P+4N+D
76 70P+6N
77 -
78 75P+N+2D
79 75P+3N+D
80 75P+5N

81 -
82 80P+2D
83 80P+2N+D
84 80P+N
85 -
86 -
87 85P+N+D
88 85P+3N
89 -
90 -
91 90P+D
92 90P+2N
93 -
94 -
95 -
96 95P+N
97 -
98 -
99 -
100 100P

The lowest number is 77, and there are 12 such numbers under 100.

Also solved by Naomi Markovitz, Avi Ornstein, Bill Wold, Brian Leibowitz, Donald Savage, Harry Zaremba, Matthew Fountain, P. Michael Jung, Winslow Hartford, and the proposer, Walter S. Cluett.

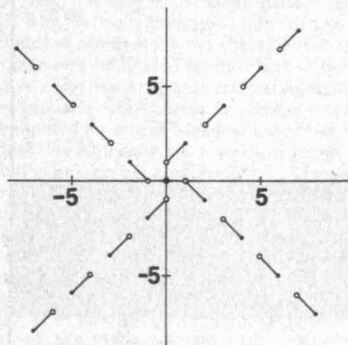
N/D 5. Find functions f and g satisfying

$$\begin{aligned} f(f(x)) &= x \\ g(g(x)) &= -x \end{aligned}$$

for all real values of x .

Our final solution is from Charles Sutton:

Two simple solutions to the functional equation $f(f(x)) = x$ are $f(x) = -x$ and $f(x) = 1/x$, while the more general $f(x) = (a + bx)/(-b + cx)$ includes the first two as special cases. To find solutions of the equation $g(g(x)) = -x$ is more difficult. If $g(a) = b$, then $g(b) = -a$, $g(-a) = -b$, and $g(-b) = a$, so the four points (a, b) , $(b, -a)$, $(-a, -b)$ and $(-b, a)$, one in each quadrant, all lie on the graph of $y = g(x)$. Since these points form the vertices of a square with center at the origin, it follows that the graph will be unchanged in form if rotated 90° about the origin, with four congruent parts, one in each quadrant. Since there can be only one value of y for each value of x , it is clear that the graph must consist of isolated pieces of curves, alternating between the upper and lower quadrants. Using straight-line segments of slope one in the first quadrant, one can piece together the graph shown.



Small circles at the end of segments mean that the end point is missing, and the dot at the origin means that $g(0) = 0$. Infinitely many other solutions of the functional equation $g(g(x)) = -x$ can be constructed by the following procedure. Start with a set of isolated arcs of curves, all having positive slopes and all lying in the first quadrant above the line $y = x$, and construct a second set by reflecting the first set in the line $y = x$. Then adjust the two sets in such a way that the projections of these two sets on the x -axis completely fill the positive x -axis, with no points on the x -axis being the projections of points from both sets. [This will require a "missing point" at the end of each arc.] Then reflect the second set in the x -axis to obtain a third set. The first and third sets constitute the graph of the function for positive x . This is because the point (a, b) reflected in the line $y = x$ becomes (b, a) , which becomes $(b, -a)$

when reflected in the x -axis. Rotate 180° and add the isolated point at the origin to obtain the rest of the graph.

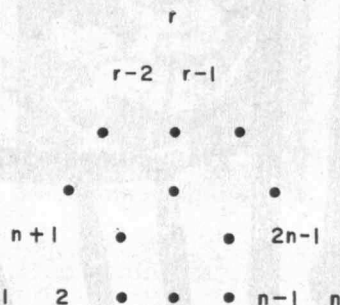
Also solved by Avi Ornstein, Bin Ly, Brian Leibowitz, Gerald Leibowitz, Greg Huber, James Landau, Jerry Grossman, John Prussing, Joseph Keilin, Matthew Fountain, Michael Hennessey, Michael Tamada, P. Michael Jung, Pierre Heftler, Richard Hess, Robert Cherry, Winslow Hartford, and the proposer, Ronald Raines.

Better Late Than Never

JUL 1. Ray Kinsley was able to obtain the answer $(10^{10} + 3)$ on a programmable calculator unable to record numbers this large.

JUL 3. Stephen McAdam offers the following clarification:

If an n -triangle can be covered by 3 lines (with the parallel restriction), then 9 divides $n(n+1)/2$, (so 9 divides either n or $n+1$) and the number of lines in any direction is divisible by 3. First note that if there are k 3 lines involved, then there must be $3k$ points, so 3 divides $n(n+1)/2$. We now number these points as follows:



We partition the set of lines into three subsets, A, B, and C, consisting respectively of those lines with positive, negative, and zero slope. Let the sizes of these sets be, respectively, a , b , and c . If L is one of the 3 lines, by $s(L)$ we will mean the sum of the numbers of the three points which L covers. Note that if $L \in C$, then $s(L) = 0 \pmod 3$, since $s(L)$ is the sum of three consecutive integers. Also it is easily seen that if $L \in A$, then $s(L)$ is the sum of three numbers of the form x , $x+y$, $x+y+(y-1)$ (for some x and y), and so $s(L) = 2 \pmod 3$. Similarly, if $L \in B$, then $s(L) = 2 \pmod 3$.

Summing over all of our lines, we get $\sum s(L) = 1 + 2 + 3 + \dots + r = r(r+1)/2$. We already have $r \equiv 0 \pmod 3$, and so $\sum s(L) \equiv 0 \pmod 3$. Now since $L \in C$ implies $s(L) \equiv 0 \pmod 3$, we see that $(\sum_{A} s(L)) + (\sum_{B} s(L)) \equiv 0 \pmod 3$, where the subscripts mean sum over the L in that set. Recalling that the size of A is a , since $L \in A$ implies $s(L) \equiv 2 \pmod 3$, $(\sum_{A} s(L)) \equiv 2a \pmod 3$. Similarly, $(\sum_{B} s(L)) \equiv 2b \pmod 3$. Therefore, $2a + 2b \equiv 0 \pmod 3$. It follows that $a \equiv -b \pmod 3$. The above argument can be applied symmetrically. That is, choose some other side to be the "base" of the triangle so that (for instance) A becomes the set of lines with zero slope. Then we get that $c \equiv -b \pmod 3$. Already having $a \equiv -b \pmod 3$, we get $c \equiv a \pmod 3$. Again by symmetry, we conclude that in fact $a \equiv b \equiv c \equiv 0 \pmod 3$. Now from $c \equiv -b \pmod 3$, we get $c \equiv -c \pmod 3$, so that $a \equiv b \equiv c \equiv 0 \pmod 3$. This proves that the number of lines in any one direction is divisible by 3. Clearly the total number of lines is $a + b + c$ which is divisible by 3, and so the total number of points, $3(a + b + c)$, is divisible by 9, as desired.

Proposers' Solutions to Speed Problems

SD 1. 1.714 seconds. He is on top of the image when he is directly under the lamp. [A regular problem based on this idea will appear next issue—ed.]

SD 2. The number of LED's that are lit in an LED display of the digits 1 through 9:

1 2 3 4 5 6 7 8 9

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16 70th Reunion

Elbridge Devine writes from Pelham, N.Y., "Even though I wear a pacemaker, I am very active for my age." . . . **Maude (Mrs. Frank) Bucknam** writes from Auburn, Calif., "Such a friendly letter from you. Frank would have appreciated it so much if he had been here. He died in October." . . . **Lauriston Knowlton** has moved from Cumberland, R.I. to Houston, Tex.

George I. Crowell writes, "I keep active and go to the office every day although the pace is not as brisk as it used to be. I enjoy my dog Benji who is always there to greet me when I get home, a great companion. Spent Thanksgiving with my sons Bob and Bruce and their families and look forward to the same at Christmas. I am thankful for continued good health even though the eyesight remains impaired." . . . **Will Wyld** writes that he and Dannie spent six weeks in the Canadian Rockies last summer. He also visited his brother in Naples, Fla. last December. . . . **Francis and Paul Duff** send greetings to all '16ers.

Frances writes, "We have had a very busy summer and fall. Paul is fine. He is remarkable. The doctors can't get over him. He has slowed down in his walking, but his mind is still great. We celebrated our 60th wedding in August and 71 of our children and their families came. Our mass was beautiful—six priests on the altar and the music was so beautiful. We then came home to luncheon out under the trees."

Victor King, attorney to **Elizabeth Pattee**, sends a letter: "Mrs. Pattee is presently confined to a wheelchair but otherwise is her cheerful self, albeit sometimes a bit limited by the effect of her inability to enjoy her long-time interest in walking. She probably would easily remember you on the telephone. Her care at Meadow Lakes has been great. Presently she has a series of nurse-companions to keep her company." . . . **Donald Dunbar** writes to say that his father, **Victor Dunbar**, passed away July 6, 1983 at age 93. He was a retired auditor with the U.S. Government. Donald says, "I know he would have appreciated your letter, as he often spoke of his happy days as a student at M.I.T."—ed. (**Bob O'Brien**, Acting Secretary, H.E. Fletcher Co., Groton Rd., W. Chelmsford, MA 01863, (617)251-4031 or 935-3750, ext. 204)

18

As usual I sent greeting cards and best wishes for 1986 in early December. I am indeed happy with responses, some of which I am incorporating in this issue.

From **Maude (Mrs. Earl) Hatten**: "For Earl, I am writing to thank you for his 92nd birthday card. He was so pleased to receive it, and kept the card for days in his pocket to show. His therapy is to go to lunch each day, have a beer, then at four to have a toddy of bourbon and water. I also thank you for making him smile." . . . From **Bill Collins**: "Three years ago January I landed helpless in the hospital, a victim of a virus which attacks the nerves and muscles. After ten months of hospital-



ization and nursing homes, I am now home again caring for my needs and crawling around with a cane at 90 years. I have heard of your retirement home with all of the extra services. I'd be at a loss in such surroundings. Everything I have has to be acquired the hard way. I'm still expected at family gatherings to carve the monster turkey and wash dishes. I wouldn't have it any different, I imagine."

From **Giles Hulseman**: "Health and spirits never better. Prefer staying in these mountains in winter and am still running uphill in this 7,800-foot altitude. Need no glasses for reading or driving. Eat too simply to travel—mainly whole grains soaked in water overnight. I carry it with me flying around to visit family. The world is nuts at present, and I don't think old people always thought that. It's just possible I'm the one who's nuts."

From **Judith and Harry Stephens**: "Judith is 12 years younger than I am and this stimulates me to keep active. We belong to the Linger Longer Health and Exercise Class which works out each weekday morning at Ft. DeRussy on the big grassy area next to the beach at Waikiki and try to swim in the ocean each morning and afternoon. Ninety-one people attended class today, and we hope to grow to the 200 mark established the day after Christmas last year. We have fantastic appetites and fully enjoy the wonderful buffets available at the big hotels."

From **Jean and Julian Avery** in Juno Beach, Fla.: "Julian is a very old man, nearly 90. Walking is hard and speaking is hard and he is vague and forgetful, but up and about and so patient. Everyone loves him here, and we are happy to have so many nice friends. Lots of bridge for me and all sorts of doings. I do miss my family and old Boston friends, but for us I think this was the right choice—no harsh winters."

From **Stuart Caldwell**: "None of us are getting younger and I'm sure need help to surmount the trials of later life and to avoid the pitfalls of a wobbly and much changed economy. Though I feel at least ten years younger than I am, I know that we must sooner or later do what you have to

do. All this whets our interest in your move into North Hill and a great curiosity about the whole concept of retirement living. Some day in January or February we might drive around and call on you—des rolente—maybe you have found a 'club' we also could enjoy." . . . In addition we were happy to receive greetings from **George Halfacre** and **Rhoda and Charlie Tavenor**.—**Max Seltzer**, Secretary, North Hill, Apt. B403, 865 Central Ave., Needham, MA 02192; **Leonard Levine**, Assistant Secretary, 519 Washington St., Apt. 15, Brookline, MA 02146

19

While you may read these class notes in April, they are written in early January and are mostly dated around the holiday period. As an example we received from **Bob MacMullin** and his wife **Olive** a full-page holiday card. They say, "Seems like we're still playing the old game, in our second childhood, Honest Injun! Health: aside from some passing discomforts (Olive, dermatitis, Bob, shingles), our doctor tells us we're in pretty good shape for our age (late eighties). Homecoming: all three of our kids (Beth, Connie with Brad, and Bruce) were with us for a week in July. We all had a wonderful time. Books-on-cassettes: Nioga Library continues to lend us a couple of books each week. Bob spends several hours each day listening, trying to keep up. Exercise: Bob still walks a mile or two daily, fair weather or foul, to keep limber." . . . **Barbara and Don Way**, **George Michelson**, and **Doc Flynn** all advised us they are doing well.

Francis A. Weiskittel writes, "We are getting quite old as evidenced by memories. One of mine is the school dinner or some such affair when it was announced at the Walker Memorial that a revolution in Russia had occurred and the Bolsheviks took over. Was it October 1917? Returned safe and a little untanned from the annual trip to Disney World with my 40-year-old retarded son. Greetings to all Course XV classmates."

Best wishes to all '19ers for a good summer.—**W.O. Langille**, Secretary, P.O. Box 144, Gladstone, N.J. 07934, (201) 234-0690

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Your secretary's heart was gladdened by messages from a goodly number of classmates, namely **Buzz Burroughs**, **George Des Marais**, **Bill Dewey**, **Frank Maconi**, **Ed Murdough**, **Ed Ryer**, **Lee Thomas**, and **Phil Wait**. Another heard from was **Vera Howes** whose husband, **Homer Howes**, was one of our most distinguished classmates.

Bink Carleton tells about his cruise on the *Royal Viking* ship from New York to Montreal and back to New York last September/October. I wish I had known about it beforehand, for it happens my daughter and her husband were on the same cruise and would have been delighted to meet the Carletons.

Harold Bibber writes that he remains active in the Engineers Foundation of Ohio, helping to counsel students interested in an engineering ed-

ucation. . . . A letter from **Eric Etherington** tells of his activities as a public utility specialist in California. He has an interesting life, and it's good to know that he is still going strong. . . . **Sam Schenberg** writes that he celebrated his 65th wedding anniversary last June. Sam says he has many happy memories of his years at M.I.T. . . . Word from **Carleton Alexander** indicates that he maintains interest in the Institute and the class of 1920. He resides at 1408 East 300 St., Wickliffe, Ohio.

I regret to report the death of **Ted Bossert** of Carnegie, Pa. on November 24. Ted was a staunch member of the class, and his loss will be keenly felt by his many friends in the class.—**Harold Bugbee**, Secretary, 702 Country Club Heights, 3 Rehabilitation Way, Woburn, MA 01801

21 65th Reunion

Welcome, sweet springtime! Only two months to our 65th reunion. It's 15 years back to our wonderful 50th reunion when we got our red jackets. I still wear that handsome jacket at all M.I.T. functions, or whenever three of four of us get together for a mini-reunion around the luncheon table. **George Chutter** was our 50th reunion chairman, and I was saddened to learn recently that his widow Marion died early last summer.

Most of the news this month came from Christmas cards. For the sake of class notes, Christmas should come four times a year. Cards came from **Leo Pelkus**, Betty (Mrs. **Norman**) **Patton**, Celia (Mrs. **Frank**) **Huggins**, **Helen St. Laurent**, **Velma** (Mrs. **Sanford**) **Hill**, **Emma** (Mrs. **Leon**) **Lloyd**, **Ruth** and **Irving Jakobson**, **Millie** and **Herbert Kaufmann**, **Dorothy** (Mrs. **Joseph**) **Wenick**, and **Helga** and **James Parsons**.

Leo Pelkins wrote that he would see us at the reunion in June. . . . **Betty Patton** is still working. Last June she flew to California, went to Yosemite Park, Monterey, Disneyland, Las Vegas, and the Grand Canyon, and in October to Niagara Falls. . . . **Celia Huggins** wrote her usual delightful Christmas letter. Her apartment was flooded last fall when a storm sewer overflowed and she had to move out. She is now back. During the year, she traveled around Florida, camped in the Everglades, and toured the coast of Maine. . . . **Helen St. Laurent** spent four months this past summer in Center Lovell, Maine. She plans to come to the reunion. . . . **Emma Lloyd** wrote that she spent two months with her daughter in Atlanta early in the year after her daughter had a ruptured appendix. Late in May she saw **Bob Miller** and **Whitney Wetherell** at Sandwich, Mass. In September, she flew to Switzerland, motored through the French Alps and boarded a ship in Nice for a week's cruise on the Mediterranean. October saw her in London visiting with her daughter **Barbara**. Sounds like a busy year.

Dorothy Wenick wrote that her son **Martin** is currently in Washington with the state department but goes abroad frequently. Her son **Dick** had plans to spend a month visiting her in Florida. . . . **Helga** and **Jim Parsons** were leaving on a round trip world cruise on the *Royal Viking Sea* late in January. I expect they sat at the captain's table as the captain is **Helga's** cousin. **Jim** says, "See you in June."

Bob Miller wrote last November of a trip in which he planned to stay with his daughter **Peggy Weaver** for nine days in Naples, Fla. He phoned me on December 14 and reported that he stopped a few hours in Tampa and saw **Graciela** and **Helier Rodriguez**. **Graciela** is having eye troubles and her sister was staying with her. While in Naples **Bob** set up a luncheon date which included **Herb Gwynn** and his wife, and **Dick Windisch**.

An Alumni Fund envelope from **Arnold Davis** tells of his 85th birthday celebration in Liberty, Maine, 62 people present. **Arnold** is the oldest of 12 living brothers and sisters. Following the celebration, **Arnold** and his wife visited relatives in Maine, Massachusetts, and Connecticut.

I am indebted to **Sam Spiker**, '25, for sending me an obit for **Fairfield Raymond**, who died in Peterborough, N.H. on November 10, 1985. **Fairfield** was an avid conservationist who worked as a consultant on many environmental issues. In October 1984, the **Raymond Trail** on Mt. Monadnock was dedicated to him. **Fairfield** graduated from Harvard in 1918 before coming to M.I.T. He was an assistant professor in the old Course XV and was involved with the beginning of the Sloan School. He served in the navy in World War I. During World War II, he served on the war production board. In 1948, he became business manager of Browne and Nichols School and served on the board of overseers.—**Sumner Hayward**, Secretary, Wellspring House E64, Wash. Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, Assistant Secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

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A letter from **Lee Carroll** tells of a pleasant vacation in Jamaica last December—weather and snorkeling super. **Lee** still acts as investment counsel for a few of his old, old clients. He is looking forward to our 65th. **Lee** also comments on the death of **Art Fischer** (noted in the August/September Review): "He was a great pianist, could play Beethoven or Bach as well as dixieland. He played the piano for my band in college and New York when it was tough to make a buck."

From the February 1985 issue of *Mining Magazine*, London, England, we have further information about **Art's** illustrious career. He studied chemistry at Brown (and M.I.T.) and then obtained his doctorate in physical chemistry in 1926 from the Kaiser Wilhelm Institute in Berlin, Germany, writing a pioneering thesis on the theory of bubble adhesion in flotation, under the direction of Professor H. Freundlich. **Max Planck** was one of his examining professors. On his return to the U.S., **Art** joined the Guggenheim Brothers with the assignment to develop an improved flotation process and collector for the company's El Teniente mine in Chile. Under his direction the first commercial **Minerex** collector for acid circuit flotation was manufactured in 1928. This accomplishment earned him his place in the history of flotation reagents as a developer with **Keller** (xanthates) and **Whitworth** (dithiophosphates) of the three main families of modern flotation collectors. He directed **Minerex Corp.** from its inception in 1929 until his retirement as president in 1974. He continued as a technical consultant to the company until it was sold by the Guggenheim interests in 1978.

The loss of **Art Fischer**, **Frank Gage** and **Dave Minton** reduces our group of crack pianists to one, **Bill Elmer** (are there others?). **Bill** was one of the four soloists playing in a piano recital at the Faith Lutheran Church in Andover, Mass. last December.

Bill says, "My fingers still move with agility and velocity although I told our minister's beautiful wife, who is our church organist, 'Oh, to be 80 again!' Out Baching Bach has been my hobby and escape from the profundities of asymmetric reflector design that God has permitted me to pursue in depth as I push 90."

Clara Silverman, the widow of our classmate **Abraham George Silverman** who died in December 1984, has made a generous contribution to the Alumni fund in memory of her husband with the suggestion that it be used to purchase new books for the chapel or the library. Thank you, **Clara**. Let us hope this is an example others may follow.

Ed Merrill sends the good news that he and **Vicki** continue well in Tulsa. We count on them to come to our 65th. . . . **Madeline** and **Parke Appel**, class president, are well and looking forward to June '87. **Parke**, now retired for 21 years from New England Tel and retired from the presidency of the M.I.T. Club of Southwest Florida and the presidency of the Veno Chapter of Telephone Pioneers, continues his active life as president of

the Harbour House Corp., lay reader and member of the choir at St. Mark's Episcopal Church in Venice, tax aide for NARP, and director of Tuesday Venice Isle Club.

Bertha S. Dodge is the author of the book *Cotton: The Plant That Would Be King* recently published by Texas University Press. . . . A good note from **Edward J. O'Connor** says, "Not very active now—business career over but still interested in N.H. Explosives and Machinery Corp., owned by my oldest son, and O'Connor Equipment of Lawrence, Mass., owned by my youngest son. My experience as N.E. sales manager for different construction machinery companies helps them now and then. Still quite active in golf at Andover Country Club, shooting my age now and then in the 80s, but the holes are much longer and the hills much steeper than a few years ago." Let all the golfers bring their clubs to the 65th, and we will go out to Braeburn for nine holes.

Dr. James Wallace, who took his master's in public health, died sometime in 1983. His home had been in Arnprior, Ontario, Canada. No details are available. . . . **Winthrop F. "Win" Potter**, who for years could be counted on to be at the Alumni Day luncheon to meet old friends, died December 12, 1985 in Lexington, Mass. He is survived by a son, three daughters, seven grandchildren, and one great-grandchild.—**Yardley Chittick**, Secretary, Box 390, Ossipee, NH 03864

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The Watertown Chamber of Commerce has instituted the **Charles T. Burke** award for service to youth. . . . **Hugh Chase** notes that he is doing short and easy hikes but that he has largely lost the sight of one eye. . . . **James Evans** died August 15, 1985. He graduated with our class in electrical engineering. After graduation he became an electrical engineer for Boston Edison Co. until his retirement in 1985. During World War I he served in the U.S. Army.

Albert Gordon died September 26, 1985. He attended Worcester Polytechnic Institute before entering M.I.T. in 1920. He graduated with our class in electrical engineering. After graduation he joined **Crompton Knowles Corp.** in Worcester and remained with the company until retirement in 1965. During that time he worked in the laboratory, was foreman of maintenance in the engineering department, and was in sales engineering. After World War II he remained in manufacturing and acquired the title of manager of manufacturing engineering. Prior to retirement he moved to Paxton, a small town near Worcester, and in retirement he lived in South Yarmouth on Cape Cod. He belonged to many clubs in Worcester and on the Cape and was prominent in civic activities. He was much occupied with woodworking and gardening.

Harry Kent died sometime in 1985. He graduated with our class in electrical engineering and obtained also a master's degree. Upon graduation he joined the Edison Electric Institute in New York City and became director of engineering there.

Howard Russell died November 24, 1985. Prior to entering the Institute he attended the Military School of Military Aeronautics, Cornell, 1918. He graduated with our class in mechanical engineering. He was very active in alumni affairs—class representative on the Alumni Council, assistant secretary, secretary, vice-president and president of our class, and director of the Manchester, N.H., M.I.T. Club. He was a World War I pilot, and with the late Colonel **Walter E. Richards**, was a founder member of the Order of Daedalians. He was a fire protection engineer, licensed in several states, and from 1944 until his retirement in 1961 was general manager of Improved Risk Mutuals in White Plains, N.Y. He was also adjutant and deputy commander, the Silver Wings of World War I; charter member, Society of Fire Protection Engineers and the Weary Club of Am-

herst; president, Rotary; director YMCA; trustee, Home Savings Bank; and president and director, Community Chest. He was a fighter pilot in the 141st Aero Squadron, 4th and 5th Pursuit Group in France and Germany. His hobbies were amateur radio, color photography, and playing the organ. He recently had been appointed third vice-president of the class to replace **Tom Drew**. Now **Royal Sterling** has appointed **Lem Termaine** to replace Howard.

Charles Schell died September 12, 1985. He graduated with our class in civil engineering. He became superintendent of Public Works at Ravena, N.Y. and assistant sanitary engineer of the New York State Health Department.

Lieutenant Colonel **Alexander Stuart** died sometime in 1984. He was a graduate of the Coast Artillery School and of the Ordnance School at the Watertown Arsenal, the Command and General Staff School, Army War College, and Army Industrial College, Washington, D.C. He took graduate studies at M.I.T. and affiliated with our class. His first assignment was instructor in engineering and mine defense at the Coast Artillery School, Fort Monroe, Vir. In 1915 he was ordered to Corregidor, Philippines and in 1917 to the Engineering Division, Office of the Chief of Ordnance for duty with the American Expeditionary Force in Europe. At the war's end he was appointed chief of the Ammunition Supply Division, responsible for the destruction and care of large amounts of ammunition produced in this country before manufacture could be stopped. Next he was made successively ordnance officer of the Ammunition Division, Washington, D.C.; chief of manufacturing, then commanding officer, Picatenny Arsenal; and director of War Plans Division, Office of the Assistant Secretary of War, Washington, D.C. As a hobby he made a study of population control and wrote a book, *Overpopulation: Twentieth Century Nemesis* published in 1958. He wrote also a treatise, "Democracy on Trial."—**Richard H. Frazier**, Secretary/Treasurer, 7 Summit Ave., Winchester, MA 01890

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The most shocking news of this issue is the death of our class vice-president, **Herb Stewart**, at age 83 in Waban Mass. on January 6, 1986. A memorial service will be held in the spring, at a time to be announced, in the Union Church in Waban.

Herb was a specialist in high-voltage transmission systems and was involved with the overall design and operation of the New England Power energy-supply network from 1930 until his retirement in 1972. Subsequently he practiced as a private engineering consultant serving international clients of Charles T. Main Inc. of Boston.

During World War II Herb was 'loaned' by the New England Power Service Co. to the U.S. Office of Scientific Research and Development. He served on the staff of the Harvard Underwater Sound Laboratory, where he supervised manufacturing contracts for submarine detection devices. During the war period he was also on the staff of the M.I.T. Radiation Laboratory, whose mission was radar systems engineering. From 1925 to 1934 he was employed by Westinghouse Electric Corp. in Pittsburgh and Boston. Herb was active in M.I.T. alumni affairs throughout his career.

Continuing work into his eighties, Herb wrote a chapter on Utility Central Power Stations for the updated *Kent's Energy Systems Handbook* published by John Wiley and Sons in 1985 and maintained a life-long interest in classical music. He played the violin which he had taught himself to do as a youngster in rural Maine. Married to the former Winifred Hughes, who died in 1982, he leaves one son, Robert H. Stewart of Waban, who lived with him.

A note from her daughter informs us that **Heleen Gill** (Mrs. Charles Welling) passed away September 25, 1985, in Bennington Vt. She earned an S.M. in chemistry, but we know nothing of her career.

Frank Billings wrote **Don Moore** congratulations on Don's daughter's (Professor Sandra Faber) astronomical scientist honors. Frank spent winter 1983 in London and winter 1984 in Victoria, B.C. He shuns winter hot spots, but keeps busy in Newport, Washington, at church, senior citizens, and various board meetings. He is 87, aiming for 90.

Doug Montgomery reports from Ventura, Calif. that everything is going smoothly and quietly.

... **Chris Conway** writes from Louisiana that his health is good and that he still is active gardening, and in community concerts, theater, and church work. ... **Addison K. Wills** moved last January from his home of 21 years to an apartment in Tryon, N.C. No change in p.o. box or telephone. Glad to be relieved of house maintenance.

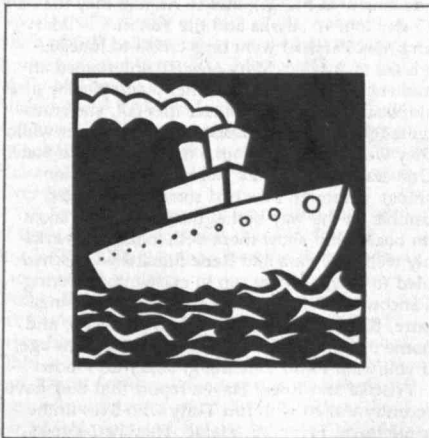
While **Dick Shea**, consulting electronic engineer living in Sun City, Fla. for the winter, is playing golf, he turns out a whimsical column, "Shea's Lounge" about every two weeks for the local newspaper.

Paul Schreiber and his wife spent three weeks in Hawaii at Waikiki Beach and islands. They toured Honolulu and were aboard the beautiful *S.S. Independence* for seven days visiting the scenic islands of volcanos, lava beds, waterfalls, and picturesque whaling villages. The ship's meals were sumptuous and the entertainment very professional. They were happy to be back in Florida after a glorious trip.—**Russ Ambach**, Secretary, 216 St. Paul, No. 503, Brookline, MA 02146

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Adele and **Ed Kussmaul** sent holiday greetings from their winter home in Boynton Beach, Fla. ... **Eleanor** and **Fred Greer** write to say how sorry they were to miss reunions at M.I.T. and Smith last June. During August and September they drove up to New England and spent the time looking up relatives and old friends. They have ten grandchildren and seven "greats." ... **Marion** and **Franklin Fricker** report that they attended the Fricker reunion in Albany last August. Nearly 50 relatives made for a great time. In November they traveled to California to visit relatives and old friends. ... **Mildred Hitch** and **Ben Oxnard** write from Atlanta. They find getting around now rather difficult, but if the right occasion presented itself they would likely be ready to take off.

Elinor and **Sam Spiker** are spending most of the winter months in Brookline, Mass. They had a week in California for Christmas and were planning three weeks in Naples, Fla. in March. ... Our loyal classmate in Japan, **Kamy Kametani**, recalls his days at the reunion and indicates he would like to come here again. ... Also, greetings were received from **Lil (Mrs. Garvin) Drew** in Laguna Niguel, Calif.; **Frances (Mrs. Avery) Stanton** in Wellesley, Mass.; and **Virginia (Mrs.**



Irving Symonds in San Antonio, Tex.

The Alumni Fund office sends a note from **Don Taber** in which he says that following the reunion he and **Billie** spent four weeks in Scandinavia, Germany, and Switzerland. Also, they were guests on a 65-foot sailboat from Nantucket to Newport with a stop at Martha's Vineyard. Luckily that was a week before hurricane Gloria struck on September 27. At the end of October they went to Florida for the winter. ... **Temple Patton** reports that he is recovering from a stroke he suffered last May.

Sam Spiker provides the following information: "**William F. 'Sonny' Sonnekalb, Jr.** of Summit, N.J., died there on the night of September 27-28, 1985. He had had a stroke in June and appeared to be recovering quite well until he was afflicted with pneumonia about two weeks before his death. We were both members of Phi Beta Epsilon fraternity at M.I.T. and have been very good friends ever since. He was the business manager of the Tech Show during his junior year. After graduation he worked in the U.S. Patent Office in Washington during the day and attended Georgetown University Law School in the evenings. He became a patent lawyer with the firm of Howson and Howson. Later that firm was dissolved, and he became a partner in the firm Davis, Hoxie, Faithful, and Hapgood, the last three of whom were M.I.T. graduates—**John Hoxie**, **Ted Faithful**, '26, and **Cy Hapgood**, '33. **Dick Whiting**, '26, whom most of our class will recall as a lead in the Tech Show and a member of several jazz bands is also a member. **Dick, Cy**, and I attended the memorial service for **Sonny**. He is survived by his wife **Jean**, two married daughters, four grandchildren, and his sister, **Ruth**."

In reporting the death of **Willard Allphin** the exact date was not mentioned. He died on September 28, 1985. Besides his activities as previously noted, he was a founding member and director of the Danvers YMCA, a member of the Danvers Historical Society, the Friends of Glen Magna, and the Harvard Musical Association.—**F. Leroy 'Doc' Foster**, Secretary, 434 Old Corners Rd., P.O. Box 331, North Chatham, MA 02650

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60th Reunion

This issue is being written January 2, and we are already receiving encouraging news in response to the first reunion committee mailing which included the biography form. ... **Howard Humphrey** reiterates his praise of **Jim Killian's** recent book and goes on to tell of the wonderful 80th birthday party he recently enjoyed at a luncheon arranged by his wife **Virginia**.

Robert T. Rogers writes to say that he and his wife have had some medical problems this past year. He is recently out of the hospital with a new hip. "I'm a busy guy—founding trustee of County College of Plula; past chairman of the board of trustees, director, and past vice-chairman of Blue Cross of greater Plula; and director and past president of Family Source of Plula. I was in the hospital five times in last three years getting a hip replacement and recovering from subsequent infections. Hope to attend the reunion."

Henry W. Jones writes, "**Fannie** and **Crockett Harrison** celebrated their 55th wedding anniversary in August at Rock Ledge Manor on the Atlantic in Rye, N.H. It was attended by 19 immediate members of the family and numerous other relations still residing in the area. After a few weeks of visiting, the Harrisons moved on to the warmer climes of Williamsburg, Va.

Joseph C. Manian of Bethesda, Md. died December 26, 1985, at age 82. Mr. Manian was a patent attorney for more than 39 years for the federal government, retiring in 1965 from the U.S. Patent Office. After graduating from M.I.T. in engineering management, he began his career in the U.S. Patent Office. He went on to receive his law degree from George Washington University Law School in 1931. In 1955, he received a presidential

appointment from Dwight Eisenhower to serve as examiner and chief, Board of Appeals, U.S. patent office. Mr. Manian came to America in 1907 from Harpoot, Armenia and settled in Boston. His two recently deceased brothers, Sam and Joe, were also graduates of M.I.T. in engineering during the 1920s and held positions in the U.S. patent office and National Academy of Sciences.

We have five additional death notices, too many for our healthy class. Apparently they were derived from class mailings or other sources which would give a cumulative effect. **George S. Killam**, P.O. Box 415, Chatham, MA 02633, died May 11, 1985 and is survived by Mrs. George S. Killam. . . . **Roscoe L. Wood**, 45-090 Namoku St., G-4, Kaneohe, HI 96744, died September 18, 1985 and is survived by Mrs. Roscoe L. Wood. . . . **Theodore Taylor**, 68 Scenic Dr., Denville, NJ 07834, died November 22, 1985 and is survived by Mrs. Theodore (Edith) Taylor. . . . **Ward I. Hamilton**, 459 Antlers Dr., Rochester, NY 14618 died in August 1985. . . . **George L. Diggs**, P.O. Box 514, Cambridge, MA 02139 died sometime in 1985. If anything further could be contributed about the above alumni, particularly in the form of their biographies, it would be appreciated.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

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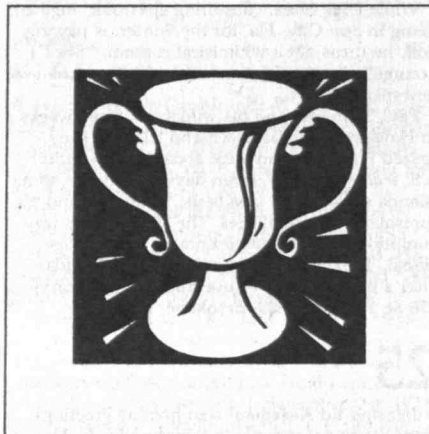
Gordon Calderwood writes from Rochester, N.Y.: "For a number of years, Lucie and I enjoyed counselling two Ukrainian and two Hungarian families, refugees from Communism. Since 1980 we have been similarly involved with three ethnic Chinese Laotian families. It is rewarding to watch these industrious, intelligent folk as they make progress toward full citizenship in our beloved country." Gordon has been involved in safety. He was corporate director of safety for the Rochester Gas and Electric Corp., on the Accident Prevention Committee for the A.G.A. and E.E.I. as well as president of Rochester Safety Council. He has done his bit for M.I.T. as past president of the M.I.T. Club of Rochester and regional class representative for our 50th anniversary fund. . . . **Fred Willcutt** from Washington says his wife Gerry died in March 1985 after having 50 years and nine months of happy married life. Fred is still on the go—to Lexington, Ky. for Thanksgiving with his son's family, including a 1-year-old grandson, then to Fort Lauderdale to visit a 1-year-old great-granddaughter.

Theodore Ordman, Stanfordville, N.Y., is still recovering from a compound ankle fracture that occurred way back in June 1984. Nevertheless, Valda and I took a cruise via Royal Viking Line from San Francisco to Vancouver, Glacier Bay, Juneau, and Sitka, then return to Victoria, B.C. Assists by wheelchairs at airports and to and from San Francisco docks were a great help to me. I no longer refuse any help, but a cane is best for mobility at home." A retired patent attorney, Ted has overcome his affliction of deafness by lip-reading. Congratulations and best wishes. . . . **Alfred W. Schuster** of El Paso, Tex., died on October 11, 1984. He was an insurance broker all his life and a partner in Schuster and Skipworth General Insurance Agency. His hobby was model railroads. Alfred was chairman of his area in 1960 for the Alumni Fund and was cited as an "outstanding chairman." . . . **Gustav A. Brunn** of Raymore, Mo. died on October 12, 1985. He was professor of mechanical engineering at Finley Engineering College in Kansas City. Thanks to his widow Pauline from Foxwood Springs Living Center for notification.

Carl H. Anderson of Sun City, Ariz. died August 21, 1985. In 1955 Carl was a transmission engineer in Albany N.Y., serving also Elsmere, Utica, and Syracuse. He retired to Sun City in 1967 and was a director of the Home Owners Association. In 1976 he was a trustee of Community Hospital and its foundation. A good part of his

life was with fund raising for charitable causes. Thanks to his widow, Louise, for notification.

Sidney E. Blandford, Jr., of Denver died in June 1985. After five years of engineering work, he went on for a medical degree from the University of Colorado. Then after four years in the army and two years in the South Pacific, he returned to Denver to private practice as a plastic surgeon. Sid was a fellow in the American Society of Surgeons. . . . **Robert W. Carr** of Batavia, N.Y. died on April 17, 1985. Trained in electrical engineering, he worked for Westinghouse for three years. Then he joined his family business and later managed C.L. Carr department store, Batavia's finest store. In recent years his son Stephen has taken over his duties.



John E. Jacobson of Texas City, Tex. died on September 14, 1985. Trained in mechanical engineering, John was a registered professional engineer, a member of ASME, ASCE, and the Texas City Rotary Club. He was retired as president of Gulf Coast Dredging Co. Thanks to his widow, Elizabeth, for notification. . . . Sympathy is extended to the widows and families of our classmates.—**Joseph C. Burley**, Secretary, RFD 3, Epping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Branford, CT 06405; **Prentiss I. Cole**, Assistant Secretary, 2150 Webster St., Palo Alto, CA 94301

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To all of you who sent us year-end holiday greetings, our thanks and deep appreciation. It is a particularly happy time for a class secretary; long-silent voices are heard again and there is usually a welcome influx of material.

Betty and Dud Smith had a busy year. They celebrated their 55th wedding anniversary in March, Dud became 80 years old in May, granddaughter Judy graduated from Wellesley (with one course at M.I.T.), and in August they took a 15-day tour to Alaska and the Yukon. . . . **Mary and Max Parshall** went on a cruise to Juneau, Alaska in August. Mary (age 80) entertained an audience of about 500 with her piano playing at a shipboard talent show. Later that fall, she entertained at the Brown Palace Motel in Denver while they were returning from a trip to Colorado State University (where Max still has active relationships). Although Max had some heart-related trouble on the way home, their snapshots taken on board ship show them both looking remarkably well. . . . **Pam and Rene Simard** were scheduled to take a 34-day trip in midwinter covering Vancouver, Fiji, New Zealand, Australia, Singapore, Bangkok, Hong Kong, San Francisco, and home to Canada. Their philosophy: "At this age, if you want to do something, better do it now!"

Priscilla and Roger Haven report that they have recently visited with **Jim Tully** who lives in the same town, Fryeburg, Maine. They had a good

talk and Jim was in good spirits. . . . **John Melcher** tells us that he has now moved to a "life care" apartment and that he likes it. . . . **Velma and Charlie Worthen** expect to change their address once again in June of this year. . . . **Henry Buntschuh** is justly proud of his oldest granddaughter, Ingrid, who graduated from college last June. She traveled with Henry through India, Ladakh, and Nepal and now teaches physics and biology in Kenya, near Nairobi.

Eleanor Pepper is working on a traveling exhibit of the Alliance of Women in Architecture. She also lectures at three college-level schools on finishing building materials to be used in interior design projects. . . . **Arthur Robinson** enjoyed an early summer auto trip last year to visit with his brother and family in Maine. . . . **Alexander Tsongas** is continuing his family genealogy research and spent five weeks in Greece last summer getting additional information.

We are delighted to have cards and notes from a number of our '28 widows. **Dorothy (Mrs. Carney) Goldberg** is well and very busy. You will recall that Dorothy was honorary chairman of our very successful 55th reunion. . . . **Mary (Mrs. Arthur A.) Nichols** will spend the winter months in Florida. . . . **Marjorie (Mrs. John A.) Carvalho** has teamed up with another M.I.T. widow for a trip to the "Land of the Maya" as members of an M.I.T. tour group. . . . **Frances (Mrs. Carl F.) Meyers**, with a friend, took a tour of Rome, Assisi, Egypt, and Israel in December 1984 and were in the Holy Land for the special Christmas season events.

It is that era of our class history when 50-year wedding anniversaries abound. **Ruth and Abe Woolf** celebrated theirs by repeating, as nearly as possible, their original honeymoon trip. This meant traveling to New York by train and staying at the same old Waldorf Astoria Hotel. They were unable to obtain their old room but got the corresponding one on the next floor. Upon arrival they were greeted by flowers and champagne from their family. To a wonderful couple, our hearty congratulations and wishes for many good years ahead! Since Abe is class of 1928 60th reunion chairman, he is already busy preparing the groundwork and would like some suggestion input from the class. If you have ideas to propose, please write to Abe. In a previous issue of class notes we told of the clock repair episode at Ye Castle Inn in Old Saybrook, Conn. during our 10th reunion. That was in June 1938. **Roland Earle** reminds us that he too was a participant (in an advisory capacity) on that occasion. We regret that this point had escaped our memory and so was omitted from the report. After all, a bit of time has passed since that historic event! To you, Roland, our thanks for the reminder.

With deep regret we must report the deaths of four classmates. **George E. Bagby** died on October 23, 1985. George joined our class in the sophomore year. He graduated in Course XV, business and engineering administration. Our record shows that he was associated with International Nickel Co. during his professional life. . . . **C. (Charles) Henry Conroy** died May 15, 1985. Henry graduated in Course VI, electrical engineering. For most of his career he was chief engineer, Department of Public Works, St. Johns, Newfoundland. . . . **James D. Green** died August 9, 1985. James received his S.M. degree in Course I, civil engineering, but his professional work was largely in the banking business. He was prominently active in his various social and civic interests. Son James, Jr. graduated M.I.T. '65. . . . **Jue Ting Hu** died suddenly of a heart attack on October 7, 1985. This information was provided by the Shanghai M.I.T. Alumni Association. Jue joined our class as a junior after preparing at Cornell. He received his S.B. and S.M. degrees in electrical engineering. To the families of these classmates we extend our heartfelt sympathy.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

Your secretary received a number of holiday greetings and best wishes from a goodly number of our class as follows: **Claire and Seymour A. Baum**, Jupiter, Fla.; **Claire and Arthur J. Bearse**, Punta Gorda, Fla.; **Sally and Bill (W. Gordon) Bowie**, Olmstedville, N.Y.; **Dorothy and J. Russell Clark**, Dallas, Tex.; **Fran and Paul Donahue**, Nahant, Mass.; **Ruth (Mrs. Teddy) Fahey**, Ocean Ridge, Fla.; **Ellie and Jerry (Vincent) Gardner**, Belmont, Mass.; **Dorothy and Joaquin Llano**, Williamsburg, Va.; **Mary and Frank Mead**, North Port, Fla.; **Barbara and George J. Meyers, Jr.**, Wyomissing, Pa.; **Kay and Lieutenant Colonel Lawrence (Larry) Mosses**, Sarasota, Fla.; **Richard Piez**, San Mateo, Calif.; **Marion and Robert S. Pride**, North Palm Beach, Fla.; **Helen and E. Neal Wells**, Pinellas Park, Fla.; and **Chung-Foy Yee**, Canton, China.

Power of persuasion is the only way I could get a good note from **David Wilson** of West Newton, Mass., which reads: "My wife Ethel and I are proud great-grandparents of a baby girl who is now nine months old, and she is very beautiful. We have three sons and 11 grandchildren. At my age all we can hope for is about 15 to 20 years of peaceful existence. I am still working in my small business of manufacturing brassieres and girdles, employing about 250 persons. I am not planning to retire as I have no hobbies to occupy my leisure time. I started the business about 40 years ago. When the *Tech Review* comes, I actually dread the thought of opening it and finding the number of our classmates who are listed as passing on. I guess there is no way of stopping 'Father Time.' I just took delivery of a 1986 Lincoln town car which gives me a thrill second only to sex, but at my age that is mostly mental. Otherwise, I am okay. I do not feel my age. I take lots of vitamins and two aspirin every night before I go to bed to forestall any circulatory troubles."

Edward R. Godfrey of Huntington, N.Y., writes, "Just sailing my day sailer and keeping the home fires burning. I am still quite active, but my dear wife of 54 1/2 years of married life has slowed down so that travel is not feasible anymore. It is good to know that our class has a top notch secretary." . . . **William F. Jenkins** of Manvel, Tex. writes: "I am busy taking care of my arborvitae, writing poetry and songs, and leading singing groups."

I regret to announce the deaths of the following members of our class: **Colonel George G. Rogers**, of Fairfax, Va. in 1985; **Hiram A. Lyke**, of Oconomowoc, Wis., on June 3, 1985; **Arthur R. Babcock**, of Crystal Falls, Mich., on August 22, 1985; **Earl J. LeRoi**, Omaha, Nebr., on August 23, 1985; **Dr. Ralph C. Young**, of Phoneix, N.Y., on October 5, 1985; **Edward M. Tittman**, of Reno, Nev., on October 10, 1985; and **John J. Wilson**, of Marblehead, Mass., on December 31, 1985.

Upon graduation, from M.I.T. as a mining and metallurgical engineer, **Edward Tittman** spent his entire career with Asarco, which he joined at the company's Garfield, Utah plant, and subsequently Texas and Arizona. He returned to Salt Lake City in 1952 as general manager in the western department. In 1955, he was transferred to Peru as president and chief executive officer of the Southern Peru Copper Corp. He remained in Peru for four years, overseeing the development of the Toquepala mine project through its final construction phase. He returned to Asarco headquarters in New York City in 1958 as vice-president in charge of smelting and refining for the company. He retired in 1971. He is survived by his wife, three daughters, and three grandchildren.

I received a note from **Bill Baumrucker** announcing the sudden passing of **John J. Wilson**. Bill states in his note that he saw John about two weeks ago and he looked great. What a loss to our class! What a loss to M.I.T. He was one of the most illustrious members of our class, and next to his wife and family, he loved M.I.T. to

which he gave his time, talents, and money freely and gladly. He was elected a life member of the M.I.T. Corporation and in 1958 was elected president of the Alumni Association. In 1959 he became 7th secretary of the Corporation, which post he held for 20 years. It is estimated that he signed over 45,000 degrees.

He was successful in every field of endeavor. He was an incorporator of Children's Hospital and the Museum of Science and a trustee of Brigham and Women's Hospital. In 1946 he organized Doelcam Corp. and served as its president and chairman until 1955. He became vice-president of Datamatic of Honeywell in 1954 and president of Datamatic Corp., electronic data processing subsidiary. John also served as officer and trustee of State Street Trust Co., United-Carr Fastener Corp, Electric Trust Limited of London, and Reed and Barton Corp. He was an avid sailor and navigated his 42-foot ketch, *Holger Danske* on several voyages to the Baltic Sea, the Mediterranean, Africa's West Coast, the Caribbean, and the east coast of the United States. He was an enthusiastic figure skater, former president of the Skating Club of Boston. He is survived by his wife Dorothy (Simpson), three daughters—Eleanor W. Williams, Ann C. Wilson, and Sarah S. Wilson—and a son Richard B. Wilson.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

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This month's most intriguing report is from **Bill Alling**, one of our three clergymen. At the time of his 1982 report, he was teaching at the Westminster Christian Academy in Huntsville, Ala. and doing a little pastoral work for the Reformed Presbyterian Church. Shortly thereafter he accepted an assignment as a teaching missionary in Korea. Initially he lived with another missionary in Pusan and taught English Bible classes at Kosin College (Kosin is an acronym for Korean Presbyterian Church). However while he has taught a few Bible classes, most of his time has been spent teaching conversational English at Kosin. His special assignments have included teaching three brief courses at a missionary training center in Seoul to help Koreans to become missionaries and a two-week course that he taught at a small seminary in the Philippines. Last summer he accepted an invitation to live at a Kosin College professor's home with the professor's five children. He says he gets along fine with the children who call him "Hargboji," the Korean word for grandfather.

J. Palmer Boggs is professor emeritus of architecture at the University of Arkansas, having retired in 1976. He and his wife live in Fayetteville. He has continued to do a limited amount of consulting structural engineering on a pavilion museum project designed by Bruce Goff and under development in Los Angeles. . . . **Anne and Jack Bennett** continue to shuttle between their summer home in Hudson, Ohio and winter home in Sanibel, Fla. In Ohio Jack is treasurer of the Akron Community Foundation and in Florida treasurer of the Captiva Chapel by the Sea. He reports that a couple of years ago he helped **Lucilla and Bill Jackson** celebrate their 50th wedding anniversary in Manchester, Mass., an event that **Wally McDowell** also attended. He also sees **Margaret and Ted Riehl** on their trips east from Arizona. . . . **Ed Huson** reports that he is "limited by advanced angina" but is otherwise fine. The Husons recently celebrated their 51st wedding anniversary.

We have at hand reports concerning the deaths of three more of our classmates: **W. Howard Reed**, **David Stanley**, and **Herman Botzow**. Exact dates are not available, but apparently all three died in the early part of 1985. Unfortunately, I do not have any information about **Howard Reed** other than the fact that he was living in Alliance, Ohio at the time of his death. . . . As of ten years ago, **David Stanley** was a freelance writer on air transport economics and lived in Evanston, Ill. About five years ago, he and his wife Adelaide

moved to Walnut Creek, Calif., where he continued his free-lance writing and was active in the local musical society. My records indicate that in addition to Adelaide he is survived by two daughters and ten grandchildren. **Herb Botzow** had in recent years lived on and worked a farm in Hinckley, Ohio. He and his wife Martha also had a winter home in Stuart, Fla., where they decided to live permanently about a year before his death. In addition to Martha, my records indicated that he is survived by two sons, **Herman Jr.** and **William**, and three grandchildren. **Herman Jr.** graduated from Princeton, obtained an M.S. from M.I.T. in 1959 and works as a planning engineer for the New York Port Authority. **William** graduated from the College of the Ozarks and works for Eaton Corp. in Cleveland. . . . In conclusion I should like to call your attention to the fact that nearly every month I receive one or more responses that are not mentioned in the notes. The reason is that I check each response that I receive against items that have appeared in earlier columns and customarily use only those responses that contain something new. However, I do appreciate your responses, even though they may contain only items that have been previously reported.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

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55th Reunion

The most difficult task for your class secretary is to list the numerous deaths that are reported every month. Those reported this month are: **Loudon C. Page**, 38 Walnut St., Uncasville, Conn. 06182, who passed away last year; **Mrs. Karl H. Volkhausen**, 12 Cardinal Rd., Worcester, Mass. 01602, who passed away in August, 1983; **Leopold C. Topper**, Lathrop Ln., Norwich, Conn. 06360, who passed away on February 25, 1985; and **Robert E. Hodgson**, who passed away some years ago. Some of these may have been mentioned in earlier Class Notes, but not according to my records.

Now for notes from our living classmates, as furnished by the Alumni Association: **Al Sims** writes, "This past summer, while in Rhode Island, Lillian and I thought we might get over to Scotland and England, but some problems brought cancellation of our arrangements. However, we hope to take about three weeks in May and cover (mostly by rail) both areas, but especially the Scottish Highlands. We would be pleased to hear any suggestions as to what to see and where to stay. We are economy-minded, and will use bed-and-breakfasts whenever possible." **Joe Buswell** says, "Eleanor and I had an unusual and interesting trip in December, 1984, with Travco to 'The Remote Tribes of Africa, visiting Senegal, The Gambia, Mali, Ivory Coast, Central Africa Republic, Congo and Zaire.' . . . A note from **Gabriel S. Cristofalo** mentions "Being on dialysis makes it difficult for me to travel, and I have just completed a seven-day cruise on which I had dialysis at sea. We are concerned as to whether or not we can attend the 1986 Reunion, because I require dialysis at least three days a week." . . . Word from **A. Harry Wagner**: "Retired as president of Southern Brick Contractors, Inc., masonry contractors of Richmond, Va. Employed as executive secretary of the Virginia Concrete-Masonry Association."

Here's a report from **John Swanton** on a meeting regarding the 55th Reunion: "Present at the meeting were **Dorothy** and **Dave Buchanan**, **Claire** and **Ben Steverman**, **Evelyn** and **Howard Richardson**, **Charlotte** and **Ed Hubbard**, and **Louise** and **John Swanton**. **Dorothy** and **Dave** were hosts at their beautiful home in Peterborough, N.H. **Ben Steverman** reviewed the program, as outlined at our earlier meeting in April: Alumni Day is Friday, June 6, 1986. After Alumni Day luncheon, leave in buses for Wyckmere at Harwichport on Cape Cod. **Ben** has checked it out with **Henry Ahlberg** and **Shel Smith** and it looks real good. He had brochures to show us.

Clambake that evening is at the beach house—under cover, so no worry about rain. There's a heated swimming pool. Some may want to drive their cars down instead of the buses—that's okay. Charlotte reported on the contacts she had made for a possible speaker for the class dinner and inviting them to join with us. Something light and humorous met with general approval. Final decision on this will be made later. Ben read a letter Louise drafted to be sent to all widows of classmates, inviting them to join with us. Increased effort will have to be made to make sure we have a full list—some that we know of were not on the Alumni Office list. The idea of a souvenir was discussed, and met with general approval; Ben will look into this further."

Claude Machen writes, "I've been fortunate enough to keep very busy in my retirement—no problems of time hanging on my hands. One major project has been housebuilding. In 1983, we decided we knew enough about our likes and dislikes to buy a waterfront lot here in Florida and put all of our good ideas into our dream house. We have coupled the housebuilding with a fair amount of travel. We had a thorough visit to France in early summer of 1984, and then a 21-day trip to China last fall. This summer, we had a very fine trip to Northern Italy in the spring, and we returned on October 27 from a wonderful visit to Egypt. Friends don't dare visit us, for fear we'll put on a slide show! We became grandparents early this year when our younger son and his wife adopted a beautiful baby girl. That calls for a little additional travel since they are in Santa Fe, but it's well worth it. Our older son is a partner in one of the medium-sized Boston law firms."—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757; **John Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158; **Ben Steverman**, Assistant Secretary, 3 Pawtucket Rd., Plymouth, MA 02360

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We were pleased to hear from **Francis T. Gowen** who writes, "Once again we spent the month of October in Italy with our Italian family during the grape harvest. Trudie and I are still working full-time—Trudie at University Hospital and I am self-employed."—**Kenneth B. Thompson** writes that he is fully retired and enjoys some of the activities of the M.I.T. Club of North California. **Daniel D. Passov** is still very active as president of City Piping Co., Inc. He is a member of the board of Soehnlen Corp. as well as the Society of the Blind.

Thomas Hannafin worked in the steel industry in the Midwest, then went to General Electric, Lynn, Mass., where he worked on jet engines. He retired in 1973 and lost his wife a few years ago. He hopes to make our 55th reunion. . . . **John Finnerty**, our class agent for the Alumni Fund, reports that of our active 307 members 57 percent contributed to the fund. Our Sustaining Fellows class members are: **Bennett Archambault**, Mr. and Mrs. **Wendell E. Bearce**, **Cecil Boling**, **Donald W. Brookfield**, **John J. Brown**, Mr. and Mrs. **Howard F. Carver**, Mr. and Mrs. **Alexander D. Daunis**, **Byron E. James**, **Gaynor H. Langsdorf**, **John Navas**, Mr. and Mrs. **Eric P. Newman**, **Robert B. Semple**, Mr. and Mrs. **Richard M. Stewart**, and Mrs. **Carroll L. Wilson**.

Our Great Dome Associates are: **Thomas J. Anderson, Jr.**, **Edward F. Cahoon**, **Melvin Castleman**, **Timothy P. Coffey**, **Frank R. Cook**, **Julius Grozen**, **G. Robert Klein**, **Guy C. Lentini**, **Eugene F. Lynch**, **Jacob Millman**, **Willis M. Moore, Jr.**, **Robert K. Mueller**, **Daniel D. Passov**, **Archie Riskin**, **James G. Ritchey**, **Thomas R. Smith**, and **Charles H. Taylor**.

The sad part of this secretary's job is receiving obituary notices. Each month the list seems to be growing—I wonder why. **Winston Braxton** brings me news that **John A. Osterman** died after a short illness on July 30, 1985. He was a retired assistant vice-president with AT&T. During World

War II he was a lieutenant colonel in the U.S. Army and served in the Pacific Theater. He was active in the civic and social life of Darien, Conn. He is survived by his wife **Helen** and sister Mrs. **Ernst Farlgy** of Richmond, Va. . . . **Timothy P. Coffey** died on November 28, after a short illness. He was a design and construction engineer for many years with Lockwood Greene Engineers, Inc. He lived a full and active life—World War II, many honors, much travel, nine children, and 18 grandchildren. He is survived by his wife **Helen**.

Nicholas E. Rothenthaler's wife, **L. Marie**, writes that after several years of illness he died on November 2, 1985. He enjoyed our 50th reunion and was looking forward to the 55th. **Nicholas** was an outstanding metallurgical engineer with Ford Motor Co. He received many awards and honors from many professional societies. He was also active in many civic and religious (Episcopal) organizations. He is survived by his wife **Marie**, daughters **Judy Potter** (law professor), and **Anne Vendramin** (countess in Italy), son **Scott**, and six grandchildren.—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA

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Now here's a note like I enjoy getting: "Retired, alive and well!" says **Richard E. Payzant**, who now lives in Olympia, Wash. A glance at the 25th reunion annual shows him as an army man who was enjoying his work. . . . **Jack Andrews** came through with a Christmas card saying he and **Jarmaine** had been almost everywhere in 1985. They will be a fully retired couple next summer when **J.** stops teaching school. . . . **Ferd Johnson**, who lived down south for a while before moving back to New England, says there is nothing new, but he keeps ever more busy in his retirement. By the way I have addresses for all these folks if any of you want to engage in correspondence or have more information about a classmate.

Bill Pleasants, who was working on a domestic sewage treatment plant, writes from Delaware that he is working to legalize kerosene heaters and is rebuilding a coal haul railroad to their power plant. **Neil Hopkins** years ago built an eight-inch telescope and liked it so much he went on to a 12-inch one. Now he is adapting the smaller one to use on Halley's Comet—a most enjoyable pastime, he reports. . . . **Prentiss Huddleston** is still a retired consultant on specifications for architect friends in Tallahassee, Fla. . . . **Bill Harper** writes a strong supporting letter for M.I.T.'s program raising money to cover those loans and scholarships that the class of 1933 received so long ago. The younger generation deserves our support, he says. Retirement holds little attraction for him just now. . . . Word has come that **Lynn H. Hopkins** died last April in Winnetka, Ill.

As you probably know, this news is being written soon after Christmas for the April Review. It is hardly necessary to make any comment about our Carolina weather, 18° this morning. I'm glad I got to Cambridge when I had warm, rich, red blood. If and when it gets too cold for you folks in New England, come by and stay a few days with us and show **Daphne** and **Beau** how to cope with our unseasonable weather. We are always glad to hear from anyone and to have you come stay a few days with us. Happy Easter.—**Beaumont Whitton**, Secretary, 5150 Sharon Rd., Charlotte, NC 28210, (704)553-0515

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It seems to be a sad fact that we must often start the notes with word about the loss of one of our classmates. I have to report the death of **Charles W. Jerome** on October 23. He is survived by his wife, **Constance**, to whom we extend our sincere sympathy.

John D'Albora writes, "After 32 years with Bell Laboratories and Western Electric, of which 14 were in missile guidance work at Cape Canaveral

and two were at Kwajalein, I retired in 1973. We spent ten years in Florida, active in church and community affairs, and often travelled to Italy to see our daughter and her family, and to Rhode Island to see our son and his family. In 1983, we decided to spend half our time in Italy and half in Florida. Being in Italy makes it easier to travel to interesting places in Europe. Rosalie and I are in good health, thank God, and hope to do this for a long time. Sorry we had to miss the 50th." . . . **Ed Geittman** writes enthusiastically about the Williamsburg Mini-Reunion. He describes selling his big home and moving to a small house on three-quarters of an acre on North Lake. He is retired now that his children and grandchildren are scattered and do not need his help. He planned to take a cruise on the Nantucket Clipper through the Caribbean after Christmas. He hopes to see us all at a Mini-Reunion this year. We assume the lakes he refers to are somewhere in Wisconsin, which is his home state in the current Alumni Register. . . . **Evelyn Killam**, now Mrs. **Clinton A. Hoar**, writes that she is relaxing in good health and doing church work; she is president of the Women's Society, for one thing.

Father **Joseph Hahn** writes that after a second hip operation and eight hours on the table, he recovered enough to win first place in his "flight" for the golf championship at the Westchester Country Club. He is still manager for Orbis Books, putting out a new one about every seven days. He planned to go to Nicaragua this past winter to find out what was going on there. . . . **Harold Leighton** tells us that he is enjoying retirement in Ohio, but to really know what life is, he spends the summer in his home on the Maine coast with his family and new granddaughter. . . . **Bob Franklin** is away, so I am taking over this month and awaiting a report on his adventures. The most notable event for me recently was my election as president of the Maryland Retired (Military) Officers Association.—**George G. Bull**, Assistant Secretary, The Elizabeth, 4601 Park Ave., Apt. 711, Chevy Chase, MD 20815; **Robert M. Franklin**, Secretary, Box 1147, Brewster, MA 02631

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Hal Everett sends this newsy Christmas card with all his post 50th activities from Florida: "Florence and I are still enjoying the memory of our 50th, and I am still trying to balance off the joy of seeing so many '35 friends against the disappointment of missing those who did not make it. I wish we could have more than one big 50th in our lifetime. I especially missed **Dick Hughes** (co-Glee Clubber), **Gerry Rich** (deceased Glee Club and ATO brother), **Earl Megathlin** (my thesis partner), **Gerry Golden**, **Gregg Fry**, and many others. Since June, Flo and I have had a great 21-day trip in London and the British Isles, a week in Los Angeles and Sunnyvale, a New England October foliage trip (visiting children and grandchildren), a week in Canada, and a short cruise to Nassau. I'm on the Board of Adjustments, City of Flagler Beach; genealogist/registrar of the Flagler Chapter Sons of the American Revolution; membership chairman of Daytona Chapter of Mayflower Descendants; and recently joined the N.E. Historic Genealogical Society in Boston. We hope to spend this August on Cape Cod or Wellesley, where I lived while at M.I.T. Have a good '86."

Last November, **George Lykos** held his 18th one man show in La Jolla, Calif., entitled "The Artist's Eye in Watercolors," scenes of La Jolla, abroad and undersea. . . . **Alfred L. Greenlaw** sends a note through the alumni office: "Trying to interest someone in a patent on a short transonic ejector type jet engine noise suppressor that gives a slight addition in thrust. Studying history and archaeology, particularly in regard to the age of the earth. The data from truly scientific clock systems, like dust on the moon, indicate 6,000 years." . . . **Copeland C. MacAllister** writes, "Recently published a book entitled *Uncle Gus and the*

Circus, the story of Augustine Conant of Acton, Mass., who was a big part of the circus in New England from 1850 to 1870."

I am sorry to report the deaths of two more of our classmates. **Frederick R. Haigh** died in late 1984 as reported by Dorothy Haigh. If anyone has any information about him, I would be pleased to receive it. . . . **Max Wasserman** died on New Years Day after a long illness. The newspaper account gives an idea of just how active he was in a number of businesses, as inventor and entrepreneur in chemicals and plastics, followed by real estate development in the Boston area and Virgin Islands. He was a founder of the Temple Shalom in West Newton, a member of the Council for the Arts at M.I.T., and a trustee of the Cambridge School in Weston. I shall excerpt news from Christmas letters I have received in the next issue.—**Allan Q. Mowatt**, Secretary, P.O. Box 524, Waltham, MA 02254

36 50th Reunion

By the time you read these notes, I hope you will have already indicated that you will attend our 50th! If you haven't, it's not too late. Let me remind you of some of the events. We gather on Wednesday evening, June 4, for a gala welcome dinner at the 225 Club atop a Boston bank building—a chance to socialize and enjoy the view. Thursday morning will provide a variety of activities according to your tastes, and we will lunch at the M.I.T. Museum concluding with a class meeting. Mid afternoon will see us assemble in front of Walker Memorial for a class picture (inside, under the mural, in case of rain!) before proceeding to the president's house for a reception hosted by Priscilla and Paul Gray, '54. A buffet before the Pops concert will be served in Walker, and buses will then take us to Symphony Hall. Upon our return from Pops there will be an opportunity for further socializing at our reunion headquarters in McCormick Hall. Thursday is really *our day*! . . . Friday is Alumni Day with a morning symposium followed by the alumni luncheon at which announcement of the class gifts is made. Those going on to the Chatham Bars Inn will depart and those remaining may choose to join together for a Dutch treat dinner before leaving town. It is possible to remain in the dormitory until Sunday. Events at Chatham Bars will somewhat depend upon the weather, but be advised that golf, tennis, sailing, swimming, and sunning are scheduled. A clambake and a Saturday banquet are planned. There will be opportunity to relax and socialize even more before we separate Sunday afternoon. . . . Have I changed your mind if you were negative about attending? We will welcome your presence, believe me!

If you are interested in getting out on the river to row on Thursday morning, June 5, I hope that you have already been in touch with **Frank Phillips**. If not, please do so posthaste.

I regret, in closing, to have to report the death last October of **Richard B. Fox** in Boynton Beach, Fla. whence he had moved after retiring from Babcock and Wilcox in Barberton, Ohio. His widow, Virginia, may be addressed at 4520 Meadowlark Lane, Quail Ridge 637, Boynton Beach, FL 33436.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

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Charles M. Antoni retired May, 1983, as professor of civil engineering at Syracuse University. Hobbies are fishing and as much travel as possible, mainly around the U.S. In December, he returned from a week in Bermuda. Wife Elinor M's main interests are Charles and her grandchildren. Charles writes, "Quite uneventful life. Elinor's children are located in Dallas, Los Angeles, and Salt Lake City, calling for travel to those areas. My children are in New York City and Washington (a commuting marriage) and the Syracuse

area." . . . **E.L. Bartholomew** retired in 1971 as professor of metallurgy at the University of Connecticut. He owns and operates 43 acres of cranberry bogs as a grower-member of Ocean Spray. His hobbies are fishing and boating in Buzzards' Bay, vegetable gardening, firewood cutting from cranberry bog uplands, swimming, hiking, prospecting in Arizona, and using his basement workshop. Ed makes an annual winter trip to Tucson, Ariz., in early January and returns in early May. Wife Sara's main interests are fishing, boating, bridge, and crafts. They have four children and seven grandchildren. Ed writes, "At 70 I am in the best of health. I enjoy my family and participate in many of the usual family gatherings. The cranberry business is good at this time. Ocean Spray meetings, the Cape Cod Cranberry Growers Association, M.I.T. Club of New Bedford, and my hobbies provide never-ending involvement. I never awake in the morning wondering what to do. Rather, can I get it all done? What more could I ask."

Herman Brettman is semi-retired from his consulting engineering firm. His volunteer work includes serving as chairman of building committee for North Shore Community Center, Marblehead-Swampscott and chairman of building committee for North Shore Rehabilitation Center, Swampscott. His travels have taken him to Spain, Portugal, England, France, Italy, Yugoslavia, Israel, Denmark, and Sweden. Wife Beatrice's main interest is community affairs. They have two children and four grandchildren. . . . **Charles W. Dodge** retired in 1984 as chief engineer at Frost Engineering Development Corp., Englewood, Colo. He writes, "Devoting nearly full time to bible research, using a personal computer as a tool. Much travel involved for consultation and coordination with others doing the same type of research." His granddaughter, Stephanie Dodge, is a senior at M.I.T. majoring in civil engineering with a Navy R.O.T.C. scholarship. . . . **Frank D. Lewis** writes, "Making a start on writing memoirs of my experiences as an engineer (mostly microwave, radar, and RCM in World War II, and aeronautical radio—microwave blind-landing)."

David N. Summerfield is semi-retired as a self-employed consultant. He holds three patents on universal motors and has published several articles on testing and insulating small motors. Non work activities are volunteer hearing testing as an accredited occupational hearing conservationist and volunteer, AARP Tax Counseling for the elderly. Travels include visits to scattered family in Philadelphia, Detroit, Dayton, Tulsa, Tucson, Los Angeles, and Florida for a few weeks in the winter. Wife Harriet's main interests are music, Zoological Society, and volunteerism. Dave writes, "In September, I had a surprise call from **Chester Kyih-z Nie** of Shanghai, China, who was in the U.S. visiting relatives. We got together for a delightful day of reminiscing about Tech. Chester had returned to China after graduation and worked for a utility company in Shanghai. He is married and has five daughters (like Eddie Cantor, as he put it to me). He expressed considerable optimism over the direction of the Chinese government under the Deng regime. I had a pleasant association with Chester at Tech, when he and I collaborated on our master's thesis under Professor Edgerton. As for myself, I keep as busy as I care to be with my consulting work and volunteer jobs. In the summer the foregoing activities are supplemented with a bit of golf and swimming and lots of walking year-round." Chester and his wife, Virginia, also saw **Charles P. Cardani** in August, 1985, for a three-day visit. Charles writes, "We had a very enjoyable reunion and hope that they will be able to return in 1987 for our 50th Reunion."

David F. Tuttle writes, "Returned to teaching at S.F. State this year (after a year at Stanford-in-France); retired officially six years now, don't know when to stop." . . . **Albert A. Woll** is self-employed at Woll Enterprises, Inc., and "wouldn't dare retire." Non-work activities are community services, St. Mary's Medical Center,

Boy Scouts of America, trustee, and attending adult education classes. His travels have included Mexico, Panama Canal, Caribbean islands, Brazil, Amazon, Southeast Asia, Australia, and New Zealand. Wife Pearl died July 2, 1985. Al writes, "Daughter Helaine Feudelman is expert on American folk art and antiques and is author of several books. Son David is active in my business and letting me travel." He has three grandchildren.

. . . I regret to report the death of **R. Spencer Rutherford**, P.O. Box 191, Harford, PA 18823 on August 1, 1985. He was retired from Bethlehem Steel Corp.—**Lester M. Klashman**, Assistant Secretary, 289 Elm St., Apt. 71, Medford, MA 02155; **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155

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Bill Eaton writes that he is "way out in Eugene, Ore., where the deer and the antelope play, and sometimes the bears and Indians run up and down the main street." . . . **Tice Boissevain's** wife Helen passed away in 1979. Tice has retired twice, once from Electric Boat, and then from Stone and Webster. Nevertheless, he is still a glutton for punishment—with his new wife Ethel, he is running a computer business while he is writing a book on music and his memoirs, to be called on *Anecdotal*. Tice presently lives in Noank, Ct. . . . **Leon Baral** retired last year after 45 years with Davison Chemical. Leon has been doing some traveling, and has volunteered for a year as a trained counselor for a new program, "Peer Passage."

Bob Solomon has been working part-time in a consulting capacity, but by the time you read this, he will have retired "to a home on the waterway in North Carolina." . . . **Barney Oldfield**, who is a fellow Cape Codder, reports that he is still working as a consultant to small businesses. Barney is also writing the "great american high tech novel." As he puts it, this is the best way to raise money for our 50th reunion class gift.

Marge Johnson sent a note to say that her husband, **Walter Johnson**, passed away very unexpectedly on November 9 at his "dream home" at Fort Myers Beach. Walt had retired from A.W. Reed, Inc. and had been looking forward to the 50th reunion. In the course of the M.I.T. Alumni Fund telethon last fall, it was ascertained that **Ollie Kangas** had passed away. I do have a recollection that Ollie had been ill for some time.

Next week, at the request of **Dave Wadleigh**, I am attending a planning session in Cambridge on the 50th reunion, which reminds me to remind you to save June 1-5, 1988 for that stellar occasion. And, if you can find your way to Dedham on June 6, 1986, our mini-reunion dinner will be held at M.I.T.'s Endicott House.—**A.L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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We are saddened by the deaths of four classmates. **Fred Grant** and **Seymour Sheinkopf** sent Boston newspaper reports of the death during November of **Bob Cassleman**. Fred ushered at the service held in the Second Church, Newton, Congregational. Yolande and **Ernie Kaswell**, Sylvia and **Seymour Sheinkopf**, and **Aaron White** attended. Bob's many career achievements including leading a plan to reorganize the state government in Massachusetts under two governors. He was a marketing executive of the Polaroid Corp. and later associate director of Boston's Museum of Fine Arts. He authored a book entitled *Continuum*.

Joe Mazur phoned to report the death during November of **Charlie Friedman**. After serving with the navy during World War II, Charlie founded Acme Well International Corp. and, as its president for many years, exported equipment to drill for oil and water. Charlie was active in

community affairs and served as president of the school board and a leader in the Democratic party.

Arthur H. Cook practiced architecture, designing schools in the Hartford area until 1974 when he retired. He was living in Chatham prior to his death last September. . . . **Myron A. Cantor** died February 9, 1985 in San Diego. There were no details.

Joe Zeitlen retired from full-time teaching at Israel Institute of Technology to become professor emeritus and do part-time research and consulting. Joe's three daughters and one son are following their father to make their careers in Israel in academia and computers. . . . **Dr. Lloyd P. Hunter** has been professor emeritus at the University of Rochester for about four years. These days he is studying molecular biology and ethics and competes in the national soaring contests. Classmates may have the benefit of his flight teaching on most Saturdays.

George Cremer phoned from Lemon Grove, Calif. that **Ben Badenoch** is establishing new records these days as a high flyer. Ben designs and flies fixed-wing high-performance gliders which use motors only for takeoffs. In nationwide competitions Ben has earned championship medals. George continues active in retirement with many travels and occasionally speaks before technical societies. . . . **June and Meredith Wardle** devoted three years to extended cruising in their 28-foot sailboat. From their base in Seattle they cruised to Juneau, Ketchikan, the Bahamas, and the upper Chesapeake. Their next major cruise will be to Nome, Alaska, and they say: "That's not the end of the world, but you can see it from there."

Morrie Nicholson retired after almost 30 years as professor of metallurgy at the University of Minnesota. During the last 14 years he directed the University-Industry-Television-for-Education System. In 1981 he was honored by the Distinguished Service Award from the ASEPCDD (Continuing Professional Development Division). Morrie writes: "I'm looking forward to the 50th in 1989. Our 45th was great!" . . . **Anne and Fred Schaller** write from Shaller Street in Wellesley: "Harold Chestnut visited in September. His activities in SWISS (Supplemental Ways for Improving International Stability) have caused him to be a contributor and an editor of a book on the subject and to visit more than 50 countries. Then Judy and Henry Littlejohn visited in October. They were on their way to Florida to accept delivery of a Kat Ketch, a boat with innovative rigging and push-button controls to make possible almost all handling from the cockpit."

"The Schallers' 'new boat' has taken the form of an 1825 colonial house in Wickford, R.I., the Jabez Bullock House. The fact that our new grandson is in Wickford was not supposed to have influenced that. Over Labor Day weekend I helped son Bob move his (old) boat from Rhode Island back to Marion. Spending the day watching a hazy shoreline stand still while making an all-day spinnaker run that required constant attention was hard work, but we had a fast trip. Back at the homestead, our backyard racoons ate all our peaches, and only electric shields saved our grapes. The racoons are now 'animals non-grate.'"

Antonio Arias reports he does consulting work in his retirement. . . . **Morgan C. Y. Sze** plans retirement during December from Allied-Signal Inc. . . . **Aletta and Bob Touzalin** have been touring Europe for about five months, piloting rented boats on the canal networks of the United Kingdom, France, Holland, and Germany. During their travels they have become expert in many things, including the spelling of city names and districts in Wales. Being of Dutch descent, Aletta probably pronounces Welsh easily, but we'll have to wait for the next report to learn about Bob's expertise in pronouncing "Llangollen" and companion throat and tongue twisters.

Anita and Bill Wingard continue to be unique, and our admiration and votes of thanks enfold them as they continue being productive while the

rest of us retirees are mostly loafing. Doc writes: "Our two sons are now in Wingard and Co., one in sales and one in engineering. You can guess who the janitor is."

I am grateful to have had the privilege of receiving M.I.T.'s guidance for four years and happy classmate associations for 50 years—so far. So I end today's notes with a suggestion to classmates. Probably you have come to know that career contributions we have made to society and to our families have been due, in significant part, to "tooling-up" provided by M.I.T. Also, we know we paid M.I.T. only half its costs to educate us, and the same cost imbalance exists today. Let's review our estate-planning positions during 1986 and re-evaluate a new show of gratitude to M.I.T.—**Hal Seyoka**, Secretary, 1415 Seaciff Dr., N.W., Gig Harbor, WA 98335

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John Burr writes that he is retiring from the University of Oklahoma chemistry department on May 15. He is ready for a new challenge, what to do after retirement. He won't have much trouble since the last three summers have been spent in Cambridge, England, and he will continue that. John has done some work in the physical chemistry department there as well as play going and museum crawling, both in Cambridge and London, including antique searching.

Received an interesting letter and other material from D.J. and **Charlie Edwards** at Christmas time covering their successful winery activities, i.e., "The Merry Vintners." They thought the 45th reunion was a great affair and are looking forward to the 50th. After Woodstock they, along with Mary Margaret and **Walt Helmreich**, enjoyed a few days with Marian and **Bob Gould** over in Winnepesaukee/Mirror Lakes, N.H., where they also had a reunion with Jane and **Dick Talpey** who have also retired there.

Sam Goldblith has recently announced his intention to step down after seven years as M.I.T.'s vice-president for resource development to return to teaching and research as professor of food science in the Department of Applied Biological Sciences. President Paul E. Gray, '54, announced to resource development staff members that a national search for a successor has been initiated, with the hope that a replacement will be selected before the end of the academic year. Sam will remain in his present post until a successor is appointed and after that will serve on a part-time basis as senior advisor to the president for resource development. President Gray paid special tribute to Sam for a remarkable record in developing new resources for the university, particularly from overseas industrial concerns.

A news clipping indicates that **Andy Kay** is now chairman, chief executive officer, and chief financial officer for Kaypro Corp., Solano, Calif.

Once again sad news to report regarding deaths of fellow alumni. A letter from **John Beattie's** wife, Mildred, informs us that John died on June 14, 1985 at his home in Stamford, Conn. He is survived by his wife and three sons. . . . **Allen Craig of Dalton**, retired ordnance systems engineer at General Electric Co. in Pittsfield, Mass., died on August 13, 1985 at the Berkshire Medical Center in Pittsfield. Allen worked at G.E. for 40 years, retiring in 1981. He taught material and processing courses in ordnance systems and had earlier worked in Schenectady, N.Y. He is survived by his wife, Katherine, two daughters, and three grandchildren. . . . A note from the Alumni Association informs us of the death of **Richard Spalding** on September 11, 1985. He is survived by his wife, who now resides in Fremont, Ind.

A note from **Alan Thewlis** indicates that he is continuing his retirement in San Diego, Calif. For the last several years, Alan has worked as a volunteer at the San Diego Maritime Museum helping to develop a maritime research library which should become the finest on the West Coast. . . . **John Vanderpool** writes that he has entered the

business of making athletic wheelchairs for marathoning and basketball with **Bob Hall**, nationally known wheelchair athlete. Last year they produced over 100 chairs, all made completely to each individual's requirements. He says that it certainly has been very rewarding.—**Donald R. Erb**, Secretary, 10 Sherbrooke Dr., Dover, MA

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45th Reunion

Edith Corliss writes, "On the way up to our summer place in Maine, saw my former roommate at Tech, **Fran Karpan**, '42. She is still working at the Columbia University Dental School as adjunct professor. Spoke to **Gladis D. Provost** who is now into metalcrafting. Have seen **Marvin Stein**, '42 a number of times. He and **Dottie** are retired but have their own marketing survey firm. I am principal author of an IEEE info paper on the subject of acid rain. Expect to have both the Sierra Club and Great Northern Paper on my neck."

Sterling H. Iverson, Jr. writes, "After 29 years in the navy (retiring as captain in 1970) and 13 years in academia (retiring as dean of the college of business at The American University in 1983), I am now starting my third career in the real world—small business. I am vice president, finance of Control Environment Systems, Inc. of Rockville, Md., looking for venture capital to expand production of the Flexiwatt (TM), an automatic dimming device for fluorescent lamps. Honeywell is now test-marketing our product. Looking forward to seeing you all at our 45th reunion."

Leo E. Farr, Jr. writes, "Retired June 1980 after 31 years of developing computers at IBM, Endicott, N.Y. Moved to Asheville, N.C. area. I spend six months of the year seeing North America in a travel trailer with my wife **Dottie**. Raised three children, who are raising our grandchildren. Retirement is like a constant vacation. . . . **Ivor W. Collins, Jr.** writes, "Traveled to Tahiti, Fiji, New Zealand, and Australia last spring; re-visited my old World War II scenes in Australia with a navy friend and our wives. Great trip!" . . . **Zwi Fang Li** writes from Beijing, China that his retirement was approved on October 3, 1985. . . . **John F. Sexton** writes, "We have had an excellent response to our first mailing—146 people are planning to take part in our 45th reunion.—**Joseph E. Dietzgen**, Secretary, Box 790, Cotuit, MA 02635

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After years of free-lance consulting, **Lou Rosenblum** has gone full-time with Compulux Co., which does multilingual business automation in Lowell. Also from Lou, a note about a unique program in India of "Rural Energy Centres Based on Renewable Sources of Energy" operated by **Nanu Amin's** Jyoti, Ltd., in Vadodara. . . . The last word on acid rain, from that guru on the subject, "**Alan Katzenstein**: His article from the *Water Pollution Control Association of Pennsylvania's Magazine* concludes, "Acidity from the sky does not seem to be the primary explanation for problems with fish and trees in the northeastern United States and it may not be significant at all."

Alan MacNee is teaching two courses and doing a little research on circuit modeling and design. . . . **Al Hayes** is in his tenth year as a consultant after taking early retirement from Lockheed. He just built a new home/office/guesthouse complex literally on the Yucca Valley, Calif., airport and would be delighted to host drive-in or fly-in guests from the class. . . . **Warren Loud** is teaching and researching at the University of Minnesota. He spent Thanksgiving with four grandchildren in Chicago, and Christmas with his son, a student in India. . . . **Benno and Bob Curtis** are both retired. They visited one son in Edmonton and another in Vancouver, and then cruised from Tahiti through the Society Islands. . . . **Don Stein** retired as director of the Ship Design and Acquisition Division of the Military Sea-

lift Command in Washington. Don writes that he has enjoyed his career in "Naval Arch." and says, "Thanks, M.I.T.!"

Janie and Chuck Lawrance send news: Chuck actively operates Lawrance, Fisk and McFarland, doing engineering and city planning, and just finished working on the Master Plan for the city of Santa Barbara, which is his hometown. He was recently elected to Tau Beta Pi and became a life member of both the American Society of Civil Engineers and the American Waterworks Association. They installed Loran-C on their cruiser and have done some sailing out of Redondo to Santa Cruz and other ports. . . . **Irv Fagerson** retired after a long career at the University of Massachusetts. Irv was in the Department of Food Science and Nutrition and was chairman of the Graduate Studies Committee. During his stint there, Irv supervised a total of 30 Ph.D. and 63 M.S. candidates.

Art Power continues his activities as principal process engineer at the Solar Energy Research Institute in Golden, Colo. He does interviewing for the Educational Council, is secretary of the M.I.T. Club of Colorado, and plays piano in his quartet, offering "old standards and showtunes of our day." . . . A commercial for a new campus group, Friends of M.I.T. Crew: Send them a contribution, or direct part of your Alumni Fund gift to them. Write to: "Friends of M.I.T. Crew, Pierce Boathouse, Cambridge, MA 02139." They help enhance the crew programs and put out an interesting quarterly newsletter.

A very belated obit: **Everett L. Meley, Jr.**, passed away in Houston. A graduate of Course IX, he was general manager of Oil Cities Transportation Co. Our sympathy to his wife, Helen, and to the family.—**Ken Rossett**, Secretary, 191 Albarmar Rd., White Plains, NY 10605

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Charles R. Hetherington writes from Calgary, "I am president and CEO of Panarctic Oils Ltd., an industry/Canadian Government consortium that explores for oil and gas in the Canadian Arctic about 2,000 miles north of Calgary. We have found very large quantities of natural gas and crude oil in this inhospitable area. In September 1985 we made the first commercial shipment of crude oil out of the arctic by icebreaking tanker.

D. Read Stevens brags about having been retired for years but remaining active in hiking, tennis, flying, and travel. . . . **Paul Speicher** shows up at annual fraternity reunions. He has retired from the navy, but has gone back to the same job as a civilian.

Eugene R. Davis of Wellesley, Mass., passed away last November 1. He was an executive environmental engineer for the Boston consulting firm of Metcalf and Eddy. Over the course of his career, Eugene was a civil engineer with Worthington, a naval officer in World War II, and an environmental engineer for Morris and Knowles in Pittsburgh. While living in Pittsburgh, he taught evening classes in sanitary engineering and fluid mechanics at Carnegie-Mellon. We extend our sympathies to his wife Ruth, his three sons, and the other members of his family.

Charles A. Hathaway (Course II, Tau Beta Pi and Sigma Xi), died November 22 in Dover, N.H. After serving in World War II as a navy lieutenant, he started work for the Torin Corp., in Torrington, Conn., becoming president and a director 1969-74. He was also vice-president and general manager of the Accurate Forging Corp., Bristol, Conn. His last position was president and general manager of the N.H. Division of IMC Magnetics, Rochester, from which he retired in 1983. Surviving are his wife Rena, three children, and numerous other family members. We offer them our condolences.

You guys who send in notes with your Alumni Fund contributions, please add your address and a few more details.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Henry N. Bowes, engineering and science manager for Lockheed Engineering and Management Services Co. in Houston, Tex., has been awarded the Philip T. Sprague Award of the Instrument Society of America in recognition of achievement in the conception, design, and implementation of application of instrumentation and automatic Control at NASA's Johnson Space Center. He has received numerous awards including NASA's achievement awards for the first shuttle flight, Skylab program, and earth resources program. The Institute of Electrical and Electronics Engineers has bestowed on him the Centennial Medal for Extraordinary Achievement. . . . **Randall N. Pratt** retired from the University of Delaware on June 30, 1985 as a computational specialist and keeps active with some computing consulting work while enjoying retirement. He recovered from a Reagan type cancer operation last April. He has two grandchildren with a third expected in June. . . . **Robert V. Seaman** has been traveling overseas for so long that he has lost contact with many of his classmates. In particular, he would like to reach **Maitland Baker**, **Francis Holt**, **Thor Thorenson**, and **Al Vander Wyden**. We will try to oblige.

A.B. Van Rennes is entering his fourth year in Jakarta, Indonesia as U.S. technical advisor to B.J. Habibie, Indonesia's minister of state for research and Technology. Mr. Habibie has been assigned the task by President Suharto to transform this fifth most populous country into an industrial nation. To this end, he is establishing two institutions to enlarge the very small number of engineers (less than 40,000) in a country of 160 million people. One is an interactive, hands-on educational science center (museum) for Indonesian youth; the second is a new Indonesian institute of technology patterned after M.I.T. IIT will be located adjacent to eleven industrial development laboratories and an industrial development park. . . . **Walter W. Turner**, professor of electrical engineering at the University of Maine, is the recipient of an award from Region I of the Institute of Electrical and Electronic Engineers for his long dedicated service to the student community and for his development and support of activities and professional awareness. . . . **Edwin G. Roos**, vice-chairman of Williams Real Estate Co. in New York, writes of present activity in investment and development of real estate in addition to the leasing, sales, and management of previous years. He enjoys visiting other parts of the country, particularly skiing in Colorado and spending time on Fire Island in the summer. Ed cautions that while real estate is very strong at present in New York City, it is cyclical and not to get too exuberant over present conditions. Milena and Ed both enjoyed the Williamsburg Reunion and the opportunity to meet so many good people.—**Andy Corry**, Co-secretary, Box 310, W. Hyannisport, MA 02672; **Lou Demarkles**, 53 Maugus Hill Rd., Wellesley, MA 02181.

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Holiday burnout tends to wash out inputs, but I'll try to hang in there with some names listed in the *Alumni Register* I haven't mentioned before. The premise is that they are all alive and well at their last known addresses (LKAs) and that someone will write to me if he/she knows otherwise.

John Dudley, a Course Viller out of Swamscott, Mass., listed as an associate professor of physics at Colby College and living in Waterville, Maine. . . . **Ted Eliades**, a West Roxbury lad with his letters in Course II, working for Con Edison in New York while living in Fanwood, N.J. . . . **Harvey Freeman**, another Course II mechanic, who runs his own independent engineering company in Troy, Mich. where he lives. . . . **John Gautraud**, a youngster from New Hyde Park, N.Y., who found his way through Course VI, working for

Northrop as a vice-president in its Precision Products Division in Norwood, Mass. and living in close-by Waltham. . . . **Gene Gehrig**, from Illinois/Wisconsin, who got his B.S. in physics with us and his M.S. in Course VI a couple of years later. Evidently he did go home again—to teach at the Illinois Institute of Technology in Chicago, with an LKA of Evanston.

Bob Goodstein, a Brooklyn boy who greased through Course II and went on to the farthest reaches to become a technical manager at Boeing, Seattle, LKA on Mercer Island. . . . **John Green**, a down-eastern from Waterville, Maine, who plugged into Course VI and made it through the drain, also going far afield to southern California to manage a Scubapro company in Rancho Dominguez while abiding in Tarzana. . . . **Jerome Gu-menick**, out of "Baltimore" cranked up his Course II degree only to return to the D.C. area to work at the Naval Supply Systems Command in Alexandria, Va. and camping out in Silver Spring, Md. . . . **Frank Hagerty**, out of Easton, Pa., filtered through chemical engineering (10) and went on to his M.S. and Ph.D., LKA in Atlanta as a SUNCO retiree. . . . **Alex Halberstadt** from Bradford, Pa. merged into, and out of, Course XV, eventually to become president of his own company in Orlando, Fla., residing in Longwood. . . . **Mildred Lisk Holmes**, a "commuter" out of Newton, who did a Course XVI flyby before getting her Course IV letters. His LKA is Concord, N.H. with no listed affiliation. . . . **Herb Jacques**, a Quincy, Mass. local who glided through Course XVI and is listed living in Redwood City, Calif., unaffiliated.

Hey guys, I mean like listen up and check in with the old knobber.—**Jim Ray**, 2520 S. Ivanhoe Pl., Denver, CO 80222

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Semi-retired **Art Ashbrook**, Ph.D. '47, has been working on a series of research contracts involving the economies of Mexico, Cuba, North Korea, and Iran. Art still lives in Washington, D.C. . . . **Dick O'Donnell** writes: "We are enjoying retirement on Hilton Head. In the past year have seen the **Bryon Lutmans** and **Bob Seidlars** from our class as well as **Bill Maleys**, '48, and **Alex Halberstadt**, '46. All are doing well.

John Cowan is now vice-chairman and chief financial officer of UAL, Inc., Chicago. Your real reunion committee continues to work on the 1987 bash, having only recently recovered from the practice bash at Newport. (See dearth of news, above.) The Fantastic Fund committee is working its way up to the Big Givers. Someone will be calling YOU soon. Remember, we total the five years before and the five years after for the 40th reunion gift. Do specify the 1947 Professorship, too. We want SOMEONE to remember us in a hundred years.

Please send on your news items. If you don't want to write about yourself, finger a classmate. Love—**Virginia C. Grammer**, Secretary, 62 Sullivan St., Charlestown, Mass. 02129

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Denny McNear is chairman of the committee for our 40th Reunion Gift. Denny wrote to everyone in the class and has received replies from 105 classmates. The 40th Reunion Gift steering committee include the following classmates: **Edward R. Allen, Jr.**, **S. Martin Billett**, **Kenneth S. Brock, J.**, **David Cist**, **George F. Clifford**, **Danile J. Fink**, **George M. Keller**, **Adolph Monosson**, **Jack C. Page**, **Peter Saint Germain**, **C. Vincent Vappi**, **William J. Weiss**, **Robert A. Wofsey**, **William R. Zimmerman**, and Chairman **Denman K. McNear**. The steering committee met last March and has had two teleconferences since then.

At present the steering committee is calling classmates to increase the volunteer group to 115 classmates. We have 978 members in our class

and the objective is ask all of them to consider a gift to M.I.T.

Denny told me that our classmates have already contributed \$2,100,000 to M.I.T. during the period that counts toward our 40th Reunion Gift. We have more than two years to contribute or to make pledges which are payable through June 1993 to increase the amount of our 40th Reunion Gift. As always, our class has shown great loyalty and support for M.I.T. Denny and the steering committee are considering an appropriate way to establish goals for the 40th Reunion Gift without intruding on each individual's decision about the appropriate gift to make at this time.

Paul Gray, '54, president of M.I.T., has written about M.I.T.'s core needs and at this time our 40th Reunion Gift Committee is seeking to provide maximum support to meet the basic needs at M.I.T. However, this does not limit you if you wish to make a gift to M.I.T. and designate the area you would like your gift to support.

Denny can be reached at (415) 541-2133 (days) or myself at (401) 245-8963. Please call if you can assist the gift committee or want any additional information. My experience with mailings to our class is that about 10 percent of the letters don't reach our classmates and this may be the first time you are learning about our plans for a 40th Reunion Gift.

Classmates in the Boston area had a mid-winter mini-reunion at M.I.T.'s Endicott House in Dedham. **Bob Sandman**, **Milton Slade**, and **George Clifford** handled the arrangements which included a band and dancing after dinner. **Graham Sterling**, who was president of our class from 1978 to 1983, arranged our first mid-winter gathering in 1978, and we have continued these parties since then. Graham and Judy were among the guests at this year's party, and Graham said it was fun to come and not have to be responsible for the planning.

Bob Sandman is chairman of our committee for the 40th reunion. After dinner, Bob asked classmates for their comments about plans for the reunion. One question he would like to answer within the next year concerns having an off-campus reunion before or after the on-campus reunion. The success of our previous off-campus reunions suggests that we continue to plan similar events. The question Bob and his committee have to answer is the method of combining the off-campus reunion with the events on the M.I.T. campus in June 1988. Our 40th reunion gift will be presented to M.I.T. during the on-campus activities in June 1988. A number of classmates have expressed their desire to hold our 40th reunion on-campus at M.I.T. One option is to plan an off-campus reunion that is not scheduled in June 1988.

It has been suggested that during the reunion we consider having a symposium on activities that can be planned and implemented during retirement. Speakers would be from the academic and business community with several case histories presented by members of our class. At least one session of the symposium could emphasize the "how to do it" aspects of new retirement activities. If you have any requests for reunion activities or programs please let **Bob Sandman** at (617) 527-2113 (evenings) or myself know about your interests.

Leon LaFrenier died on January 16, 1986. Leon was a dedicated member of most of the committees that planned our previous reunions. At our 35th reunion he singlehandedly arranged and catered a coffee and pastry buffet at the M.I.T. boathouse after the Pops concert. At our 30th reunion the clambake that we planned was in jeopardy of being cancelled due to an outbreak of red tide disease which affected shellfish. As director of food testing laboratories for the state of Massachusetts, Leon arranged to have sufficient clams tested to assure that our Clambake would not create excessive risks to our health. Leon was a vice-president of our class, assistant class secretary, and helped the Alumni Fund at their telethons. He served on the committee that planned Alumni

Day for the year of our 25th reunion and the following year. From 1978 to 1983 he was a member of the Alumni Council. Leon was awarded the Silver Beaver by the Boy Scouts of America, which is their highest award. In addition to being a scoutmaster for many years, he was a leader for many other scouting activities including camping and administrative responsibilities. On behalf of our class, I extend our sympathy to his wife, Rose, and their three children and one granddaughter.

John H. Hughes, noted sailor and teacher at Tabor Academy, died last August at his home in Marion, Mass. In 1968 he and his wife took a three-year cruise in the Caribbean and the Atlantic. On behalf of our class, I extend our sympathy to his widow and their two children.

Elias J. Corey, professor of chemistry at Harvard, recently received the V.D. Mattia award from Hoffman LaRoche. He was recognized for his "unique and profound influence on the entire field of organic chemistry." Elias has been called "one of the world's foremost organic chemists" by the American Chemical Society. Elias is known throughout the worldwide scientific community for his innovations in both theory and laboratory manufacture of organic molecules. He was responsible for the first synthesis of prostaglandins in pure form and in many tissue selective forms. These substances can now be synthesized in sufficient quantities for biomedical research into treatments for such disorders as ulcers, hypertension, and infertility. Prostaglandins are found in every cell in the body. Elias and his group have also synthesized more than 60 other complex molecules—for example, the leukotrienes, which may act as a "control valve" for airway muscles.

Another of Elias' breakthrough achievements is a new theoretical approach to chemistry which is the basis of an interactive computer program that is being developed for organizing the logic of synthesis. The program, which dates from 1966, applies computer graphics and consists of taking molecules apart mentally and considering in reverse sequence the reactions that might be used to put them together.

Elias has received several honorary degrees, more than 25 major awards, and authored over 550 publications.

Ed Gardner was appointed professor of electrical and computer engineering at the University of Colorado. Ed worked for more than 20 years for IBM as manager of Base Technology. . . . **Gordon Pettengill** is director of M.I.T.'s Center for Space Research and is involved in a range of spacecraft missions beyond the earth's atmosphere. . . . **Jay Lathrop** married last May, and they are building a new house. In addition to being professor of electrical engineering at Clemson University, Jay is director of Clemson's Semiconductor Device Reliability Research Center. . . . **Herb Lipson** is a physicist in the Air Force Lab at Hanscom Field in Lexington, Mass. He is using laser and infrared measurements to identify defects in quartz crystals used in oscillators and resonators. He used radiation hardening and sweeping techniques to remove contamination that causes defects. Herb feels he is and has always been a "bench man" who is effective in hands-on research. His wife, Gloria, retired recently after 17 years of work experience. After Gloria retired they took a vacation trip to Israel. They have children in California, Colorado, and one son living at home.

Bill Papian is about 80 percent retired. He lives in Shady Side, Md., where the West River meets Chesapeake Bay. He enjoys sailing, square dancing, and playing folk songs on a baritone ukelele.

. . . **Manuel Matnick** writes that after 29 years as vice-president, engineering, he became president of Axel Electronics, Inc., a unit of General Signal corp. His five children have produced three grandchildren so far. . . . **Stan Palmer** retired from Colby College as vice-president for facilities and planning. He will be doing some part-time consulting for Colby. . . . **Jim Guida's** highlight of the year was a three-week hiking trip in Greece. . . . **Henry Kuhl** retired from E.I. du-

Pont's Finishes and Fabricated Products Department after 36 years of service. He spends much time with his wife traveling and flying their airplane.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806 (401) 245-8963

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Drew Chemical Corp. of New Jersey announced the appointment of **W. John Kocher, Jr.** to the position of director, welding and refrigerant products, at Drew Ameroid Marine. In his new position, John is responsible for all facets of the growth of the unit, the newest sector of products and services offered by Drew Ameroid to the marine industry. He joined Drew in 1982, and most recently served as marketing manager, North and South America, welding and refrigerant products. Prior to Drew, John was vice-president, welding sales for Teledyne Readco of York, Pa. and for over 25 years held various managerial positions in the Aircro Welding Products Division of Aircro, Inc., Montvale, N.J.

Apologies to John for the delay in publishing this news. In this instance Murphy's Law prevailed, as your class secretary suffered a heart attack when the notes were sent to press. (I was holding John's news in a special spot so it wouldn't be omitted.) As I didn't author the notes for the last publication, it was omitted. By the way, I am back to work at this time and progressing nicely.

John M. Kane has been appointed sales engineer for Bomco Inc., a diversified manufacturer of formed metal products. John, who had been a design engineer for Atwood and Morrill, will be responsible for metal-forming capabilities. . . . **Dimitrios G. "Dimmy" Dimitriou** has left Sharjah, United Arab Emirates, and is now permanently settled in Palm Coast, Fla. However, he still has his various businesses in Larnaca, Cyprus. Dimmy is now semi-retired. His son and various managers run the family business in Cyprus. His son George is an M.I.T. graduate, class of 1976. . . . **Herbert D. Limmer** recently left Ebasco Services, Inc., to join ECC, Inc., energy and control consultants, in Fairfax, Va.

Professor **Carl F. Long** resigned as dean of the Thayer School of Engineering in June 1984 and, after a one-year sabbatical, returned to the faculty. He was voted dean emeritus status by the trustees of Dartmouth in 1984 and is now professor of engineering and director of the Thayer School's Cook Engineering Design Center. . . . **Will F. Nicholson, Jr.**, is now president and chief executive officer of Colorado National Bankshares, Inc., located in Denver, Colo.

Richard H. Holmberg retired from International Signal and Control and formed his own company, Sechan Electronics, Inc., to supply high-tech products in the defense electronics field. Dick became a grandfather last July. He and his wife enjoyed the 35th reunion in Bermuda and joined six other couples last August for the M.I.T. Mediterranean Cruise. Dick wants to know why you 50ites don't write to the Review?

J. Haroldo Falcao writes to tell us of the foreign trade business that he is busy with—export/import. Items such as specialty steels he exports out of Brazil, preferably not to the U.S. due to import quotas. Work stations for 3-D design he imports into Brazil for construction, mining, and architecture concerns.

We are saddened to report the death of **Milton G. "Skip" Hulme, Jr.** Skip died in August and at that time was director of Mine Safety Appliances Co. in Pittsburgh, Pa.—**John T. McKenna, Jr.**, 9 Hawthorne Pl., 10-H, Boston, MA 02114

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35th Reunion

James H. Ballou is back in Salem, Mass. after almost three years in Florida. He has re-established his practice in architecture and has never been so busy just operating his studio at home. He is

looking forward to the 35th reunion. . . . **William A. Krampert** married Dorothy Winters of Aurora, Colo. last December. He continues to do management consulting and enjoys life in Colorado very much. . . . **George E. Groves** plays a caliope in the Shrine parades. He says the old-timers enjoy it for the nostalgia and the youngsters because they never heard anything like it—songs from the era when flappers rode in flivvers, a cigarette was a fag, and everyone could sing the popular hits of the day. . . . **Christian L. Rust** retired April 1, 1985 after 25 years with Booz Allen and Hamilton, ten years as vice-president. He is living in Santa Rosa, which is 60 miles north of San Francisco, and establishing a business as a free-lance photographer, doing landscapes and portraits, and planning a book. His wife Dorothy is pleased to be back in California after many years on the East Coast. Two of their three sons are now married, with the third son planning to marry in the summer of '86.

Eli Dabora reports his eldest daughter Becky started working towards her Ph.D. in biochemical engineering at M.I.T. after graduating from Bowdoin College in Maine in 1981 and taking a year off to work at Johns Hopkins University. She is a thesis away from her degree, but in the meantime has gotten engaged to Joe Helble who is working toward his Ph.D. in chemical engineering at M.I.T. also. . . . **William H. Dorrill** is an associate professor of computer science at West Virginia University in Morgantown, W. Va. . . . After 25 years as a member of the electrical engineering faculty at the University of Rochester, **Herb Voelcker** is in Washington for a year to help the National Science Foundation launch a new division in design, manufacturing, and computer engineering and to do approximately the same thing, informally thus far, at the Defense Advanced Research Projects Agency. (The work is fun so far and the mobility is great.) He has the same (beloved) wife, same kids—now mercifully out of Stanford and CMU (almost)—and a new standard poodle named Tess. . . . **John F. Hennessy** is chairman of the board and chief executive officer for Syska and Hennessy, Engineers, the largest mechanical and electrical consulting firm in the nation. The firm was founded in 1928 and maintains offices in New York, Los Angeles, San Francisco, and Cambridge, providing single-source engineering throughout the life of a facility in planning, design, construction, maintenance, operations, and management.—**Gregor J. Gentleman**, Secretary, 600 Holcomb, Suite 1, Des Moines, IA 50313

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Last month we announced that Reed Steinmetz, '87, was awarded the Class of '52 Scholarship. Class president **Art Turner** has received letters of thanks to the class from Reed and his father, Larry Steinmetz. Reed was grateful for the recognition and Larry for the financial boost. The father was curious why his son was chosen. As the Student Financial Aid Office explained, it was for Reed's outstanding record in extracurricular activities, including crew and UROP, as well as for his academic record. In his letter of thanks Reed notes that a large portion of his education has come from these extracurricular activities. Since they are a part of the opportunity provided by M.I.T., it is certainly fitting that we help encourage those, like Reed, who make best use of them.

While it is good to receive recognition at the beginning of one's career, it is perhaps even better to receive it at—well, let's say the middle—as has happened to **James K. Knowles** and **Franklin O. Carta**. Jim received an honorary D.Sc. from the National University of Ireland last year in March. He is a professor in the Division of Engineering and Applied Science at Caltech. Frank has been elected a fellow of the American Society of Mechanical Engineers. He is a senior research engineer and supervisor at United Technologies Research Center, where he has been since 1960.

He was recognized for, among other things, analyses of experimental data on stall flutter and dynamic stall of airfoils.

It is good to recognize the domestic achievements of **Andreas Wessel**, who writes, "In 1981 I took over the family farm 20 miles west of Oslo. So now I am a gentleman farmer while retaining the job of chairman of the board of the company that I founded 27 years ago. My wife Gro and I really enjoy farming life. We have two children with their U.S. education behind them. . . . both back in Norway. Two are in the U.S. studying computer science . . . and one is still in high school. Unfortunately, none of the children has attended M.I.T."—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

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If it were not for **Nick Blazensky**, we wouldn't have any news this issue. Nick was recently named director in the telecommunications division of The Travelers Companies (data processing department). He is now responsible for site design in subsystem engineering. He has been with The Travelers for about a year and a half. He had previously worked for IBM in a number of positions, most recently as a senior systems engineer. He and his family live in Glastonbury, Ct.

Let's hear about your latest adventures.—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Ln., Fairfield, CT 06430; **Joseph P. Blake, Jr.**, Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

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Class notes are submitted by class secretaries about four months in advance of their publication. It is difficult to believe that when you are reading this, spring will be a reality. Today it is 8 degrees F. My driveway is covered with two inches of ice and we have just taken down the Christmas tree.

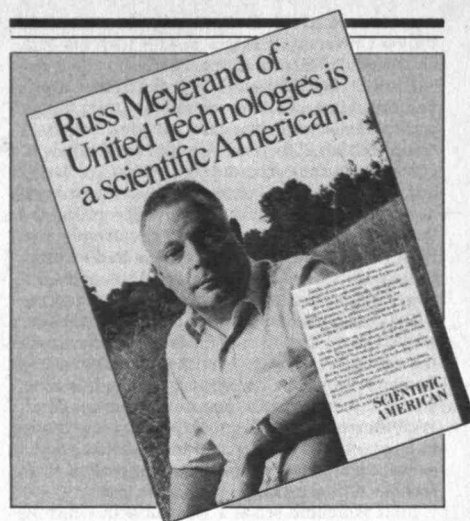
Exciting news from **Fred W. Lupton**! Quoting the Luptons' annual holiday letter: "In November, Fred received the Honeywell Golden Nugget Award. Only four of these awards are given nationally each year, and Fred was the first consulting engineer in private practice ever to receive one. He was honored for innovative energy conservation design for the Chattanooga Housing Authority—a design (using Honeywell equipment, of course!) which saves thousands of dollars each year." Their son, Frederick, is a sophomore at University of Wisconsin. Daughter Laura will be there as a freshman next year. And wife Jane has diversified her direct-sales skin-care business. Mainly she works with a friend buying, renovating, and selling old houses in their home town of Chattanooga.

Dell Lanier Venarde indicates she wants a math teaching position, or any other interesting work she can handle, in the Delaware Valley area. An offer you can't refuse? Please contact her if you're in that area and looking for help.

Allan J. Boardman reports he has become vice-president and general manager of the Advanced Orbital Systems Operations at the Aerospace Corp. He has two thriving college students at the University of California, Los Angeles, and University of California, Davis, in addition to a senior in high school. Lina, his wife of 25 years, is now a stockbroker with Bateman Eichler Hill Richards in Woodland Hills.

We regret the news from **Jean E. Smith**, wife of **George F. Smith, Jr.**, that George died of cancer August 28, 1985.

Let us hear from you!—**Robert P. Greene**, Eastern co-secretary, 37 Great Rock Rd., Sherborn, MA 01770; **DuWayne J. Peterson, Jr.**, Western co-secretary, 1841 Warwick Rd., San Marino, CA 91108



Just as Scientific American says in its national ad, Russell G. Meyerand, Jr., '55, has been reading the magazine for 40 years. But he's been reading Technology Review even longer. Meyerand's father earned S.B. and S.M. degrees at M.I.T. in 1926, and Russ remembers talking with his father about M.I.T. long before he found Scientific American at school. The senior Russ is now retired, living in Kirkwood, Maine; Russ, Jr., is vice-president—technology at United Technologies Corp., Hartford, Conn., a 17-year member of the M.I.T. Educational Council, and active in local alumni affairs.

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30th Reunion

Professor John M. Deutch, provost, informed **Bill Northfield** that Professor Bruce Musicus' two-year term as the Class of 1956 Career Development Professor ended as of last July. The new chairholder is Professor Edward Farhi, a theoretical physicist of great promise. Included in Professor Deutch's letter was Bruce Musicus' report on his activities while holder of the chair, in which he expresses thanks to the class for having given him the freedom to pursue a variety of research and teaching interests, which he outlined in his report, free from financial pressure at a critical stage in his career. Your class secretary contacted Professor Farhi, who has promised a letter outlining his planned activities during his tenure as Class of 1956 Career Development Professor. Copies of these reports will be available at the 30th reunion.

Speaking of the reunion, by now all of you should have received the final mailing and returned the forms to the reunion committee. Any of you planning to attend who have not returned the registration package should do so now.

Kenneth K. Stevenson (Course V) was appointed associate director of development for Moleculon BioTech Inc., a Cambridge firm that specializes in controlled-release drug delivery product technology. Prior to joining Moleculon BioTech, Ken was manager, operations and research, for Albany International's Controlled Release Division. During his career, he has also been associated with Hoffman-La Roche, Inc., Arthur D. Little, Inc., and the Photo Products Division of the E.I. du Pont de Nemours Co., Inc.

Ken received his Ph.D. in organic chemistry from Brown University. He now resides with his wife and three children in Derry, N.H.

Ward D. Halverson is still at the Spire Corp., Bedford, Mass. working on, among other things, amorphous silicon solar cells. . . . **Bob Follett** completed his 25th year with IBM in 1985. He is currently on the corporate staff and is involved in activities relating to voluntary national and international standards for the information processing industry. . . . **Rusty Schweikart** is currently a visiting scientist at M.I.T. where he is co-directing Project on Space Agenda: Opportunity and Context. He is also a consultant, a writer on international communications and international relations, as well as a TV host. . . . **Ed Purcell** is now with the Ocean Engineering Branch of the Coast Guard Research Center in Groton, Conn. . . . In a note attached to his contribution to the Alumni Fund, **Walt Storrer**, who does not consider his activities to be of interest to anyone, indicates that prior contribution received no acknowledgement and wonder if things will go better this year.

John Morefield sends a short note in which he enclosed a trade journal article authored by **Paul Polishuk**. John considers it an excellent treatment of fiber optics technology. Paul is now president of IGI Consulting, Inc. and chairman of the board of Information Gatekeepers, Inc., which he founded in 1977. Both companies are involved in providing information and analysis of fiber optics and telecommunications markets and technology trends. Paul had previously served as deputy director of the Office of Telecommunications of the U.S. Department of Commerce.

I am sorry to report the death of **Doretta Binner Klein** (Course XVIII, mathematics) in her home in Arlington, Mass. last November. She passed away after a long illness. Doretta, the widow of Northeastern University professor Robert D. Klein, has been involved in the early development of computers in Wall Street firms. Since January 1984, she had been employed at Compu-graphic of Wilmington, Mass. Active in Arlington politics, she had been a town meeting member and was on the town's permanent building committee and was a member of the school committee from 1971 to 1976. She had been a longtime advocate of excellence in public education and was a sponsor of Arlington's junior high school satellite program. At the time, her efforts led to the restructuring of education at this level. She leaves two daughters, Anne and Deborah, a son, Robert, and her mother, Ethel F. Binner of Hicksville, N.Y., to whom we send our condolences.—**Robert Kaiser**, Eastern Co-secretary, 12 Glen-garry, Winchester, MA 01890, (617)729-5345; **Caroline Disario Chehoski**, Western Co-secretary, 2116 W. Davies Ave., Littleton, CO 80120, (303)794-5818

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The news this month is sparse again. Most of it is gleaned from the few alumni holiday greeting cards we received. Heard from **Art** and **Bess Collias**, who just returned from the Grand Illuminations weekend at Williamsburg. What with all the houses and buildings nicely decorated with natural wreaths and candles, it was really quite a pleasant way to start the holidays. Art reports that his new company, Mitek is going very well. They have developed and now manufacture a very unique instrument used by radiologists in the diagnosis of breast cancer. Lots of interest, lots of excitement. . . . **Landa** and **Dick Hall** write that both sons are now in college: Jeff is a freshman at Colby; Rikki is a junior at M.I.T. majoring in mathematics/literature and a lead singer in the Phi Kappa Theta band. . . . And we heard from **Bob McAuliffe** that son Mark will be applying to Cornell, so we may see a bit more of the McAuliffes in coming years. . . . Next year as you send out your holiday greetings to friends and relatives, include one to your class secretaries. It

will make the spring '87 notes a lot fuller.

The *Wall Street Journal* informed us recently that **Bill Poduska**, the founder and chairman of Apollo Computer, Inc., has resigned to start yet a new company that plans to develop engineering workstations. Said Bill to the journal, "Now that Apollo is established, I hear that siren call of the wilderness and I want to do it again." As most know, Bill helped start Prime Computer, Inc. in the early 1970s.

A sad note. We were informed that Dr. **George Yerid** died earlier in the fall. George had been chief of orthopedic surgery at Lowell General Hospital. He was a chemical engineer while at the Institute. He had made his home in Chelmsford.

Finally, a glance at the annual report of the M.I.T. Alumni Fund indicates we did pretty well last year. Under Class Agent **Chuck Staples'** leadership 47 percent of us contributed some \$91,632, exceeding our 1984 results. Nice job! I see also in the report that **Bruce Hartenbaum** chaired the Spring Geographic Telethon in Los Angeles last year as well. They raised \$13,769 that night. Another nice job! Keep in touch with one of us.—**Ron Stone**, Secretary, 116 Highgate Place, Ithaca, NY 14850 (607) 257-2249

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25th Reunion

I am very sorry to report the death of another classmate in an automobile accident. **Viet Howard** was killed last July 22.

Charlie Arcand writes about his activities. The Arcands live in Kansas City where Charlie is getting into management consulting after an unpleasant time working on atomic bomb parts for Bendix. His M.B.A. from State University of New York at Albany and teaching experience from University of Southern California should help get him started. As the consulting business heats up, he is acting as "Mr. Mom" while wife Bernadette works at Professional Career Development in Kansas City. With two teenagers, Alan and Elizabeth, at home he keeps busy. Elizabeth, now 14, came down with leukemia a couple of years ago, and Charlie spent a good part of his time ferrying her back and forth to the local cancer center. The three-year treatment worked and she is cured.

Tom Geers is chairman of the Mechanical Engineering Department at the University of Colorado, Boulder. Tom's fame arises, in part, from his development of the doubly-asymptotic analysis method which is useful for underwater-shock fluid-structure interaction problems.

Ben Zarren, **Ira Jaffe**, and **Mike Wechsler** took the grand tour of Europe and Israel last October. The excuse was to attend **Hiam Alcalay's** son Roy's Bar Mitzvah in Tel Aviv. They flew over on the 15th and spent nine days running around the country. In Jerusalem they checked out the rabbinical school Ben's daughter, Phyllis, will attend next year. They also watched Hiam's daughter Daphna graduate from a military school. Women's Lib! From Israel the trio (with wives) took off for Paris or a very fancy time with **Clem Vaturi**. The weather was magnificent, unusual for Paris in October. Clem was one hell of a host running the boys around in a limo to all the posh places. After three days there, they all got into Clem's Lear jet and went over to London (Wow!). A van met them and they were escorted through customs lickety-split. Clem went off on business and the Americans hired a car for a four-day tour of southern England. Ben says the best place was a hotel called Buckland Manor near Broadway in the Cotswolds. On return to the U.S. Ben and Mike bought a condo down on the Fort Lauderdale shore. So that's how the other half lives!

Ira Jaffe is a University of Michigan nut. He goes to every Michigan game, home and away, in a van painted the school colors, maze and blue. He sits on the 50-yard line. The Jaffe basement is a shrine to Michigan football. The walls are painted with all the team numbers, team pictures are everywhere, and every type of souvenir re-

sides on the shelves. The *Detroit Free Press* has had a couple of articles about the Jaffe basement! Unfortunately the trip to Israel interfered with his going to the Iowa game. He tried to get a satellite relay to Tel Aviv through one of the networks, but it didn't work out. So, instead, he called home and had his son describe the game live from TV. When Michigan lost in the last couple of seconds, his son didn't have the heart (or bravery) to tell the whole story. It took some time or Ira to get the tragic news.

The reunion plans are now complete. The most interesting event is our rental of the Opera House in downtown Boston for a dinner-dance and for a very special performance by Gus Solomons' dance troupe. It's a grand theater and this should be a spectacular evening. I am looking forward to it and to seeing all of you.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

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Robert E. Anderson has been appointed group vice-president of Semiconductor Test at GenRad, Inc. with responsibility for divisions and product lines in California and Massachusetts. He was previously vice-president of corporate marketing. . . . **Douglas L. Barritt** writes that he is in launch systems integration at Boeing Aerospace Co. in Kent, Wash. as chairman of the mission design working group, planning a future Shuttle/Centaur mission. He married Mary Letitia Funston in 1983, and son Darris is a sophomore at Embury-Riddle Aeronautical University. Doug is also director of a soaring club. . . . **Steven J. Brams** had another book published, *Rational Politics: Decisions, Games and Strategy*. He has returned to New York University after a sabbatical at the University of Haifa in Israel.

Bruce G. Brown is professor of medicine at the University of Washington, Seattle. He is presently using computer-assisted analysis of coronary artery stenosis to evaluate new drugs for their effects in heart disease. He recently married Tia Aulinskas of Zimbabwe and still enjoys sailing. . . . **Alan G. Cameron** gave a presentation to the Boston section of the IEEE on propagation of wideband spectrum-spread signals. He joined Tedyne Brown Engineering last year. . . . **Virgil Cox**, chairman of the Department of Arts and Sciences at the Maine Maritime Academy, is author of a book, *Automation and Control for Marine Engineers*, scheduled to be published this year.

James Stark Draper writes that he and his wife Jane have two children, a cat, and a company. Their daughter Allison recently soloed in a Cessna 150 on her 16th birthday, and their son Stark pursues sports, school, and violin. The cat, he reports, does nothing. Their company is KTAADN, Inc., named for the Maine mountain first touched by the rising sun. Founded last July, it deals with space-related products. . . . **Jeremy Goldberg** visited the campus last August. He is still with the Navy Department working with DDG 993 class ships for life cycle support. . . . **Robert Heinmiller** was featured in a *Boston Globe* sports column for his sky diving exploits, numbering about 130. When he's not falling toward the earth, he and his wife operate OMNET, Inc., a custom electronic mail management company. The company sponsors an annual scholarship for women in telecommunications. . . . **George W. Hippisley** has returned to Central, N.Y. to become chief operating officer of Eagle Comtronics, Inc., a supplier of equipment to the cable TV industry. He is still active in amateur radio as K2KIR.

I received a nice letter and a tape of his wife Diana's organ concert from **Leland Jackson**. Leland is chairman of the electrical engineering department of the University of Rhode Island and his wife is music director at a church. . . . **Martin Klein** reports an exciting year at Klein Associates. Their sonar was used to help find the *Titanic* and the Spanish treasure ship *Atocha*, off the coast of

Florida. Their building has expanded to include a very large tank for testing underwater acoustic devices. News from the last half of the alphabet will appear next month.—**John Prussing**, Secretary, 2106 Grange Dr., Urbana, IL 61801

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As usual, the cold weather produced—much to my satisfaction—plenty of news to pass on that the spring is here. . . . **Ted Cohn** has been promoted to full professor at the University of California, Berkeley. He has expanded his research beyond basic studies of vision to studying falls on escalators caused by visual illusions. Ted is also “still hoping to learn to play ice hockey but [has] encountered pessimism amongst otherwise close and trusted friends.” . . . Last year **Bob Dinsmore** opened his own architectural consulting firm, specializing in laboratory and health-care projects. He has worked on medical research and diagnostic laser facilities, and is beginning construction of a psychopharmacology lab for a major psychiatric hospital near Los Angeles.

In September, **Toby Zidle** returned to Los Angeles from Stavanger, Norway, where he had been assigned by ARCO Norway, Inc., having been named manager of explorational services for ARCO International Oil and Gas. He, three children, and wife Marcia now live in Valencia, Calif. . . . **Elizabeth O’Neil**, nee Hall, is on sabbatical from the University of Massachusetts, Boston, and working with Bolt, Baranek, and Newman, Cambridge, Mass. on a developmental multiprocessor computer, a project called Butterfly. . . . The current chair of the Water Resource Planning and Management Division of the American Society of Civil Engineers is **Dick Males**. Last June, Dick ran a conference in Buffalo on computer applications in water-resource management attended by 500. He is also in his fourth year as an independent consultant.

Steve Hester is vice-president of Network Systems at Northern Telecom in Research Triangle park, N.C.—he’s in the “midst of ‘Digital Switch Wars.’” Steve lives in Durham, N.C. . . . **Cardiac Angiography** by **Steve Miller**, physician at Mass General Hospital and associate professor of radiology at Harvard Medical, was recently published by Little, Brown and Co. Steve has written about four dozen articles on imaging of cardiac structure and function. . . . **Dick Ludeman** reports he is still managing a portion of Occidental Chemical’s White Springs (I believe that is Florida) agricultural chemical complex. He sails both the state coasts and wonders how anyone can stay in Boston during winter. Good question, Richard.

Finally, I have a press release announcing that **Warren Siemens** has been appointed director of technology transfer for Martin-Marietta Energy Systems, Inc., Oak Ridge, Tenn. He has been with Martin-Marietta since 1977. Previously he was with Informatics, Inc., Rockville, Md.; Public Technology, Inc., Washington, D.C.; and Abt Associates, Cambridge, Mass. Warren got his Ph.D. in the philosophy of science from the Institute in 1973.

Please take a few minutes from smelling the roses to mail or phone some information to pass on to your classmates.—**Phil Marcus**, Secretary, 2617 Guilford Ave., Baltimore, MD 21218 (301)889-3890

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Happy Spring! It’s the end of 1985 as these words hit the paper and an especially good time of the year for class secretaries. The reason is that all good tax-conscious alumni are busy sending in their year-end Fund contributions, and at least some of you also scribble in a bit of news for this column. Actually, scribble is an unkind description; it’s my observation that the handwriting of our class is pretty good, even for people of our

advancing years. Speaking of which, be reminded that it’s just a little over three years till our 25th reunion.

Before starting in on the Fund notes, two press releases were received which provide news of our classmates. **Pat Gage** has been elected a director of the Industrial Biotechnology Association, a non-profit association formed in 1981 for the purpose of supporting the development of commercial biotechnology. Pat is vice-president and director of exploratory research with Hoffmann-La Roche, Inc. in Nutley, N.J. In this position he is responsible for all drug research with a staff of about 500 scientists. Pat has a Ph.D. in biophysics from the University of Chicago and has been very active in various professional societies and organizations. I knew Pat in Baker House and remember him as a genuinely nice person.

The second press release provides background on Applied Expert Systems, Inc. (APEX), which is located in Cambridge. **Fred Luconi** was a co-founder of APEX in 1983 and is president and chief executive officer. APEX is a developer of computer-based expert systems technology for the financial services industry. Key among APEX’s products is PlanPower, a trademarked software system which applies artificial intelligence techniques to personal financial planning. It is designed to support financial institutions and professional planners servicing the (hopefully) increasing numbers of us with incomes that warrant serious financial planning. Prior to founding APEX, Fred was executive vice-president of Index Systems, Inc. and before that an assistant professor in computer sciences at the Institute. Best of luck with the new venture!

On to a few of the Alumni Fund notes: **Bob Muhr** is living in Santa Barbara, Calif. and is a project manager in planning and construction in the facilities management area at the University of California, Santa Barbara. . . . **Bill Euerle** changed jobs within Foxboro Co. and is now manager of short-term development. His spare time is spent camping with his son’s boy scout troop. . . . **Charlie Therrien** has joined the faculty of the Naval Postgraduate School in Monterey, Calif. Based on personal observation, that is one beautiful campus! Of course, the towns of Monterey and Carmel aren’t too bad either.

Leo Cardillo writes that he and his family have resettled in Fairfax, Va. after a two-year assignment to the U.S. Embassy in Monrovia, Liberia. The Cardillo’s oldest child, Laura, is a freshman at Princeton—Leo says that he “couldn’t sell her on the ‘Tute.’” Leo and family are looking forward to renewing old friendships and enjoying some stateside creature comforts.

Larry Rabiner was promoted to head of the Speech Research Department at AT&T Bell Laboratories in March 1985. Those of us who follow the IEEE literature know of Larry’s outstanding publication record, both journal articles and textbooks. . . . **John McNamara** sends news of a career change. After 16 years with Digital Equipment Corp., he left to join the staff of Stratus Computer, Inc.

The column started off by speaking of tax-conscious alumni. As the column is being written, your secretary is also staring at a pile of receipts for relocation expenses and a copy of the pertinent rules on the investment tax credit available for a new car partially used for business. As you read the column in April, I will probably be staring at the same stuff, getting panicked as the 15th gets closer. Please help to save my sanity; mail me a note telling me your news about career, hobby, family, etc.—**Joe Kasper**, Secretary, 3807 Benton St., N.W., Washington, DC 20007

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Dave Kettner writes that he is a group leader at Lincoln Laboratory with 20 staff working on ground-based and airborne radar systems. **Jim Maskasky** is one of the staff members who joined Dave’s group last year. Dave says he is looking

for about ten more people to build a new airborne radar system. He would also like to get in touch with **Steve Grodzinsky**. . . . **Kayson Nyi** says he ran his first marathon (Philadelphia) in November 1984 in 3 hours, 41 minutes. He reports that, not deterred, he ran the Marine Corps marathon in November 1985 and finished in 3 hours, 28 minutes with “dignity intact (unlike the first time).” Kayson says he is now planning to retire in favor of bicycling where at least you can coast downhill.

Christmas brought **Suzy and Greg Schaffer’s** annual letter about their year’s doings. Greg, ever into new and exciting athletic pursuits, reports that he has switched from team triathlons (run, bicycle, horseback ride) to the single-handed variety. His horse, Cupid Ace, has become a fast friend. Greg also continues to run in races of various distances and accomplish speeds that I wish I could emulate. Following the vagaries of Silicon Valley business, Greg moved from Telmos to Sierra Semiconductor early last year. Suzy has been working at a couple of the local schools, the first of which—a “continuation school for kids that don’t fit neatly into round holes”—was closed down to save money last June. The Schaffers wished us all peace and goodwill for 1986.

Allen Hillman has joined Aavid Engineering of Laconia, N.H. as product marketing manager. Allen had previously worked for GTE Sylvania in Massachusetts and Pennsylvania. Aavid is a manufacturer of heat sinks. . . . **John Matton** has been appointed district sales manager, Power Systems Group, in the Chicago sales office of Combustion Engineering, Inc. John had previously worked for Combustion Engineering in Detroit. He has a wife, Judith, and four sons—John, Douglas, Phillip, and Christopher.

Surprise us all in 1986 and write a letter for the class notes.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

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After 14 years with PRC Engineering, **Andy Lemer** has taken the plunge—he has started The Matrix Group, Inc. which provides project planning services relating to urban, transport, infrastructure, and industrial development. He also hopes to continue his international practice, which has taken him from West Africa to the South Pacific. . . . **Donald Davis** is professor of mathematics of Lehigh University, and his wife Jean is president of the Unitarian Universalist Church of the Lehigh Valley. . . . **Jeffrey Shapiro** reports a very busy 1985 involving both a promotion to full professor in the Electrical Engineering and Computer Science Department at M.I.T. and a move to a new home in Sharon, Mass. . . . **Thomas Baer** is doing research on the physiology and acoustics of speed production at Haskins Labs in New Haven, Conn. He reports that he and his wife recently separated.

Fred Kuttner has accepted a position as regional sales manager for Rhode Schwartz Polarad, a manufacturer of communications test equipment. . . . **Richard Haberman** has been promoted to professor of mathematics at Southern Methodist University. . . . Although soft energy prices have generally caused a decline in renewable energy activities, **Michael Zutek** nevertheless believes that our country’s investment in renewable energy has substantial value, and accordingly he has remained active in the field. Of most significant note, he recently served on the Department of Energy (DOE) research panel to help set directions for renewable energy related aerodynamics research and a similar DOE/National Academy of Sciences panel regarding materials research.

Jeff Schoenwald manages programs on sensor research for robotics at Rockwell International Science Center in Thousand Oaks, Calif. It appears likely the robotic work will have an impact on the NASA Space Station. On the domestic front, Jeff reports a fall into a suburban yuppie mold—two kids, two Volvos, a psychologist wife, and a back-

yard to mow (but no dogs or cats). The only hobby for which he has time is the collection of frequent flyer points. . . . Joining the biotechnology revolution, **Robert Sitrin** has become assistant director of protein biochemistry process development and scale-up at Smith Kline and French in Philadelphia.

My wife and I recently enjoyed a theatre and dinner evening with **Bill Murray**, his wife **Jude Bolin**, and **Fred Goldman**. Our whole family spent a wonderful Thanksgiving holiday with **Edie** and **Chuck Hottinger** and their three daughters in El Toro, Calif. . . . **Steve Berger** is a staff scientist with TRW Space and Technology Group, Federal Systems Division, Redondo Beach, Calif.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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We seem to have a lot of classmates in the news, so we'll start off with what we have gleaned from the press. Magazines that cater to fellow Apple Macintosh owners regularly have an ad now, complete with a color picture of **Dennis Brothers**, that states, "For all of you who thought Dennis Brothers was crazy to give away MacTEP[®], here's MicroPhone[®]. The one he's selling." When the Mac first came out, there was a severe software shortfall, which Dennis helped eliminate by writing the first terminal emulator program; he copy-righted it but gave it away. His new program, "that goes far beyond any communications software currently offered for any computer," is being sold by Software Ventures Corp. . . . We haven't seen **Owen Franken** since the Tenth Reunion, but we keep finding his pictures: the latest was from China, on the cover of the *New York Times Magazine* (December 8, 1985). We also have a sighting of Owen by **Stephen Kanter**, who met him last year by accident at the ticket counter of the Beijing railway station. Owen reportedly has managed to track down many M.I.T. alumni who live in China and maintain a club in Shanghai. He was involved in a lot of photo projects and was headed for Qingdao. Stephen has been teaching comparative law at the Nanjing University Law Department and guest lecturing at other schools under the Fulbright program. His wife, **Dory**, is into water colors and had a show in Shanghai, and their children, **Jordan** (9) and **Laura** (4), are the only foreigners in a local school. . . . If **Stephen** and **Owen** are still in China and reading this, they might want to look out for **Shan Cretin**, who has been there five times in 15 months. Her husband, **Emmett Keeler**, is sending signals that she should find a project closer to home or else take the family on her China trips. Meanwhile, their oldest daughter has made the basketball team at Santa Monica High School. . . . From *Mass High Tech* magazine, we read that **Steve Finn** is president of **Bytex**, a company he co-founded in 1980 with a colleague from **Codex**, which specializes in electronic matrix switching systems to help control large distributed data communications networks. Last July, they opened a new 80,000 square foot plant in Southborough.

Two classmates, both faculty members at the 'Tute, were among *Esquire's* 1985 "Men and Women Under 40 Who Are Changing the Nation." **Alan Guth** was cited for his revolutionary theories about the origin of the universe and **Bob Horvitz** for his pioneering work in genetics. . . . **Tom James** has been promoted to vice-president of **Blount Energy Resource Corp.**, Montgomery, Ala., where he is responsible for all marketing and business development work. Tom, his wife **Jane**, and their two children live in the Montgomery area. . . . **Diane** and **Michael Rabinowitz** and their son, **Noah**, have moved to Falmouth, although Michael is still working for Children's Hospital. He is setting up a lead-in-baby-teeth lab at the Marine Biology Lab. Last summer the family visited the Republics of **Nauru** and **Kiribati** in the Central Pacific. . . . **Curtis Blaine** is co-owner of **Intelligent Software**, a software publishing

company that develops and markets educational software. Keeping it in the family, his daughter, **Christine**, has developed a new programming language, "KIDDO." . . . **Ellen Greenberg** has finished a doctorate in management at Columbia. She is now living in Brookline and teaching management at the University of Massachusetts, Boston. . . . We have two births to report this month. The first is **Dennis Sager's** fourth child, **Jill Rene**, born September 20, 1984. **Shelley** and **Ken Rosenberg's** newborn is named **Jessica** and was born in May, 1985. . . . Finally, we are saddened to report the death of **Paul Maguire** on April 4, 1985. He was living in Acton, Mass., at the time of his death. Our sincere condolences to his widow, **Sheila**, and the other members of his family.—**Gail** and **Mike Marcus**, Secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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My old Course XVI buddy, **Isaiah Blankson**, has joined the General Electric Research and Development Center in Schenectady as an aeronautical engineer. He was previously with the Webster Research Center, Xerox Corp., in Webster, N.Y. . . . **W. David Lee** has been rowing again on the Charles but reports, "It is different now with yells from the shore of 'go Daddy' instead of the old 'go Tech.' My oldest talks about going to M.I.T. and rowing—I think she has the right idea." . . . **Paul Beckerman** has joined the Federal Reserve Bank of New York to work on Latin American economics. . . . **Michael Underhill** has been appointed director of the School of Architecture at Rice University and continues to practice architecture in Houston. . . . **Henry Baker** writes, "I have retired from Symbolics, Inc., in October in order to enjoy life a little more. I helped to found Symbolics in April, 1980 after several years of false starts. After setting the initial marketing direction and organizing the sales force, I am extremely proud of the way the company has progressed—it passed the 600-employee mark just recently. I am now having great fun helping with the U.C.L.A./M.I.T. and Caltech/M.I.T. Venture Forum in Los Angeles."

Mike Laird writes, "Had a son born to us—a long wait for the first one, but very well worth it." . . . **Robert Wright**, his wife **Mary**, and daughters **Kim** (13) and **Katie** (7) are living in southern Idaho near Sun Valley. Bob is working as general manager of a frozen foods company and says, "This is a great area for lovers of the outdoors!" . . . **Jeff Geier** has joined **TAU Corp.**, headquartered in Los Gatos, Calif. It is a small firm of about 30 engineers, specializing in a software development for navigation, image processing, flight control, and flight path optimization for military and civilian applications. . . . **Irene Greif** and her husband, **Albert Meyer**, report the birth of their second child on November 6, 1985: **Julie GreifMeyer**.

Tessa Gardner writes, "Morey and I now have four children, ages 1 through 7, and are settled in St. Louis. I am director of the Section of Pediatric Infectious Diseases at St. John's Mercy Medical Center and am doing research on 'aricella' and clinical work in infectious diseases." . . . **Henry Levine** and his wife, **Jodi**, are in medical practice and education at Miami Children's Hospital—she in neonatology and he in pediatrics and emergency medicine. For rest and relaxation they grow orchids and scuba-dive. They do about 20 to 30 dives per month, and they also do lobstering and underwater photography—**Jacques Cousteau**, move over! . . . **John Gruenstein** has worked with others over the past year to set up the M.I.T. Enterprise Forum of the Delaware Valley. He has also worked on projects for the Greater Philadelphia Economic Development Coalition. He and his wife, **Carolyn**, had their third child, **Elizabeth**, in August, 1984. John is vice-president and economist at the Federal Reserve Bank in Philadelphia. . . . **Laura Peterson** and her husband, **David**, write from Harvard, Mass., of their

recent exploits. David started his second company in November—**Ventana Systems, Inc.** **Laura** writes, "Our house is cozy and very pretty. **Googin**, our personality-plus pet turtle, has his own small pond in the greenhouse; he loves getting his paws rubbed and being fed a sardine or scallop in the sink." Other classmates report that the **Petersons** enjoy such a fast-paced entrepreneurial existence that their magnificent home has no kitchen.—**Eugene Mallove**, Secretary, 11902 Paradise Ln., Herndon, VA 22071

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Michael Prager finished his Ph.D. in biological oceanography at the University of Rhode Island and has joined the faculty at Old Dominion University in Norfolk, Va., as assistant professor of oceanography. He has recently been working in San Diego at the Southwest Fishery Center on a biostatistical project involving the effects of pollution on fish stocks. . . . **Richard Hui** is an active member of the M.I.T. Club of Hong Kong, is a member of the Hong Kong Advisory Board, and is founder of **FUMEI Ltd.**, which specializes in high-technology trade with China. . . . **Robert Hazen** is winner of the American Chemical Society Ipatieff Prize which will be presented at the Society's national meeting in New York City in April. He is staff scientist and experimental mineralogist at the Carnegie Institute in Washington D.C., and is being honored for his studies of changes in crystal structures that occur at high pressure and temperature. He designed experimental apparatus and collected data concerning the mechanisms of crystal compression at conditions that exist deep within the earth. He is author and co-author of more than 90 scientific articles, and co-author and editor of six books.

Sue Winard has been appointed to the board of the Philadelphia-Northwest Unit of the American Cancer Society and will serve as educational coordinator for patient services and public education. She has also been appointed to the Philadelphia County Medical Society Committee on Women in Medicine; she was listed in *The Journal of the American Women's Medical Association*. . . . **Sydney Jackson** is continuing to work with the Los Alamos National Laboratory on space power needs of various S.D.I. concepts. He recently married **Kathy Rank**. . . . **Kenneth Huchra** has become full professor of astronomy at Harvard and has bought a house in Arlington. . . . **Paula J. Fines** received an Outstanding Woman in Industry award from the Tribute to Women in Industry group in the Tewksbury/Lawrence area. She is chief of the Transmission Equipment Engineering Department, which is an engineering support group at A.T. and T. Network Systems in North Andover.

Nancy J. Beckley was named vice-president of Network Systems and Product Services at Interactive Data Corp. She is responsible for the overall direction and development of the telecommunications network used by customers worldwide, and for product management of mainframe operating system and microcomputer development efforts. She was formerly director of new technology and developed microcomputer software products used in investment research and analysis. . . . **Philip Byer** is associate professor at the University of Toronto, working in the area of public project evaluation and decision making/risk management. He received his Ph.D. in civil engineering from M.I.T. and is on the board of trustees for public television in Buffalo. He has just been appointed by the government to the Ontario Environmental Assessment Advisory Committee. His wife, **Sandy**, is a freelance folk singer, musician, and story teller; they have two children. . . . **Anthony Rufalo** is professor of urban studies and planning at Portland State University in Oregon. He lives in nearby Beaverton with his wife, **Pat**, and three children. He was visiting associate professor in the department of economics at U.C.L.A. and also was at a technological university in the Peo-

ple's Republic of China.

Stephen D. Smith is professor of mathematics at University of Illinois, Chicago, and has organized a conference detailing the uses of computers in algebra. . . . **Howard Manasse** is clinical instructor of ophthalmology at the Hanneman School of Medicine and has an active private practice in the Erie, Pa. area. He is married and has two daughters. . . . **Florian Duertin**, after holding the position of manager of the systems section, has been appointed director of the digital methods division at the Canada Centre for Remote Sensing in Ottawa. . . . **Stanley Bone** has recently been appointed to the teaching faculty at Columbia University Psychoanalytic Center and will continue as assistant clinical professor of psychiatry at the College of Physicians and Surgeons. He lives in Manhattan with his wife and two children. . . . **Jesse Heines** has recently joined the faculty of University of Lowell as an assistant professor of computer science. . . . **Howard Blustein** spent last year on sabbatical at the National Center for Atmospheric Research in Boulder, Colo. He has also spent seven weeks at the Hurricane Research Division in Miami and flew into several active hurricanes. He has been on the television show, *NOVA*, discussing tornadoes.—**Robert O. Vegeler**, Secretary, Beers, Mallers, Backs, Salin, and Larmore, 2200 Ft. Wayne National Bank Bldg., Ft. Wayne, IN 46802

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Grethe Holby writes, "Most recently directed the world premier of Vincent Persichetti's opera, 'The Sibyl,' for the Pennsylvania Opera Theatre. My production of Gounod's 'Faust' was on PBS, and I am working on a new opera under a Ford Foundation grant. In October I taught two master classes in dance at M.I.T. In February, I will be having my first child." . . . **David M. Hegedus** is assistant professor in the College of Business Administration at the University of Wisconsin, Oshkosh, after five years at the University of Alberta in Western Canada. . . . **Edward M. Donie** has been promoted to group controller for business group marketing at Data General Corp. and was elected treasurer of the Sudbury Visiting Nurses Association.

Joseph Newton Fields III, who received his M.D. in 1982, is finishing his residency at Mallinckrodt Institute of Radiology, Washington University Medical Center, St. Louis, and will be assistant professor of radiology at Mallinckrodt in July. . . . **Marshall Schorin** has recently moved from Boston to New Orleans, becoming chief of pediatric hematology-oncology at the Ochsner Clinic. He married Susan Willard, a former Boston resident, and acquired a stepson in the process. . . . **Robert E. Miegel** trained in orthopedic surgery at Harvard and now practices at Newton Wellesley Hospital, New England Baptist Hospital, and Harvard Community Health Plan. . . . **Barney C. Black** writes, "I have moved to our nation's capital to join Dynamic Systems, Inc., where I will be working on mine countermeasures with the Explosive Ordnance Disposal people. To all who could not understand why I went to hard-hat diving school after graduation instead of getting into engineering immediately, here is the answer (would you believe I planned it all along?)" . . . **John G. Chamberlin** is NASA A.S.E.E. summer faculty fellow at NASA Lewis Research Labs (data communications research). He is a board member of the Wilowe Institute.

Gordon Legge writes: "My wife and I had our first child, Alexander Willson Legge, April 25, 1985. He has been an ideal baby from the start—even was born at a civilized hour." . . . **Avi Ornstein** writes, "Bernice and I finally purchased a house of our own. Several alumni helped us move last August, including **Len Tower** and **Bern (Thor) Krafsgis**. We helped the Krafsgis move into their new house in July. I continue to teach high school chemistry, run the school's service club, and serve as APO advisor at the local campus.

. . . **Edward T. Brogan** writes, "Serving as an Air Force chaplain at Kunsan A.B., Republic of Korea (promoted to major in April, 1985) and will attend Air Command and Staff College at Montgomery, Ala., beginning August. My wife, Sandy, is teaching high school in Brandon, Fla., for this year while the Air Force has me unaccompanied." **John Calcagni** writes, "I'm still with the U.S. E.P.A. in the air pollution control field. Recently was promoted to chief of the Economic Analysis Branch. My wife Meg is systems analyst with the North Carolina Department of Revenue. My two children, Carolyn (4) and John Edgar (2), are growing and doing fine."

Our Reunion is going to be a great time to see classmates. We will have it on campus June 5-8, which means dorm rooms will be available. There will be babysitters available or children under 6. For older children, the athletic department will have a youth program with swimming, sailing, computer work, and museum tours. I think it will be interesting to see if any males have hair shoulder-length or longer. Mine is so sparse that it no longer is capable of getting in my eyes.

—**R. Hal Moorman**, P.O. Box 1808, Brenham, TX 77833-1808



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Randy King finished the Long Beach and Boston Marathons this year. He practices pulmonary medicine in Long Beach, Calif. and is also investigating high-altitude expeditionary medicine. . . . **Mike Cheng** writes of a baby boy, Jason, presented him by his wife Terry last June. Mike is at Rolm as group product manager in voice applications, after five years with the company. . . . **Russell Dominique** left the government and is now doing design work for Norden Systems in Gaithersburg, Md.

John Chandler redecorated the master bedroom in his remodeled older home, after which the plumbing (more than 50 years old) began leaking. More work, more fun. On another note (his pun, not mine), John is still active with the M.I.T. Choral Society. He recently visited **Larry Esposito** in Boulder, Colo., agreeing, "We haven't changed a bit." Larry was recently awarded the Harold Urey Prize from the planetary science division of the American Astronomical Society for outstanding contributions in that field. Those contributions continue with his work in analyzing data from spacecraft visits to the outer planets. Wife Diane and he are designing and building a new home with input from daughter Rhea. . . . **Lawrence Fagan** tells of his events résumé-style—Ph.D. in computers at Stanford in 1980, M.D. at the University of Miami in 1983; he is now associate director of the medical computer science group at Stanford, and co-director of the Medical Information Sciences Degree Granting Program.

Rod Robertson works for Sohio in Alaska as

manager of telecommunications. Outside work, skiing, flying, and boating take up most of his time. . . . **Tom Lydon** writes of the dilemma of three birthdays in a week—Mary Elizabeth (5), Tommy (4), and Eddie (3). He asks, "Need any extra balloons?" Tom manages a software engineering section at Raytheon. . . . **Darryl Dawson** is on the executive committee of the M.I.T. Enterprise Forum of Chicago and is director of the M.I.S. for Soncraft, Inc. . . . **Roger Bowers** practices diagnostic radiology at a hospital in Sayre, Pa. The hospital is anticipating acquiring an N.M.R. later this year, the prospect of which excites Roger, he says. He will be celebrating ten years of marriage to Denise this August. They have three children. Old friends passing through on Route 17 are invited to visit. . . . **Howard Messing** has been at Meditech in Cambridge for ten years; he is a vice-president of hospital information systems. He resides in Brookline with his wife of five years, Colleen, and daughter Lauren.

Peter Fleischman is with A.D.P. in Manhattan, just having finished a stint in corporate mergers and acquisitions. Peter is now running one of those acquisitions, B.T.S.I. (formerly part of Control Data), in record-keeping for brokerages. He and his wife, Susan (Yale '74), have a son, Matthew. . . . **David Searls** did a Ph.D. at Johns Hopkins in molecular biology, a three-year postdoc in genetic engineering, an M.S.E. in A.I. at Penn, and is now at S.D.C. as manager of expert systems. S.D.C. is a Burroughs company, where I spend a great deal of my own time (in McLean, Va.). . . . **William Blum** spent four years as counsel to the governor of the Virgin Islands, after which he joined DeVos and Col, a law firm specializing in tax law, with offices in New York City and St. Thomas. In between, he has offered the world Andrew on June 10, 1985. . . . **Howard Brodie** has a 2-year old son, Fran, courtesy of wife Nina. Howard is doing AIDS research at S.F. General. . . . **Kamil Tulga** is the president of T.M.T., Ltd., of Ankara, Turkey, supplying the Turkish Central Bank with electronic security systems. . . . **Joe Hadzima** and Peggy had a boy, Jeffrey, in October. Joe is a lawyer specializing in business law for high-tech firms, and active with Professors Nyhart and Bloom at the Sloan School, teaching a new type of law course for managers.

Whew! Now I can tell you about my family. The exterior of Chapel Hill is just now completed. Eric is over five feet tall, which means, to those who know me, that in a year he can eat pie off my head. Jr. is in his third year of pre-kindergarten, so he's got block theory down cold, in addition to English and math. Ruth (O.C.C. '71) is holding up her end of Alpha, our D.P. company. We have just gotten to the point of talking about taking on employees to handle all the work. We feel that if you handle clients with respect and care, they will multiply, and God has blessed us in that way. I've written a large number of small mini- and micro-based systems through Alpha, and keeping them upgraded and the clients happy is a major effort. Still, opportunities to branch out are appearing, and with help we may take advantage.—**Robert M. O. Sutton, Sr.**, Secretary, "Chapel Hill," 1302 Churchhill Ct., Marshall, VA 22115

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Spring is sprung, the grass is riz. I wonder where the birdies is? Of course while I'm writing this, it is January and 7° F outside; but one must dream. A brief note to class of '74 alums in the Boston area. I took part in the fall telethon for the Alumni Fund and every time I do that, I remind myself to mention how much fun it is! I know, I didn't believe that myself, but it's absolutely true. They feed you well, they tell you what to say, and you get to talk to old buddies and M.I.T. pays for the phone calls. And don't worry about asking people for money. I talked with 36 people. Only two said no. That, I am told, is an average night. As I've said about six times, we have a

very generous class. Calling up people, asking them for money, and having them say "yes" is so much fun it ought to be illegal. The next telethon is mid-May. Why not give it a try for one night?

Ran into **John Hurd** in 10-250 at an evening lecture. He looks great. Lost the pot belly. John is president of Graphic Horizons, Inc. in Cambridge, having left Computervision over a year ago. John says "Now that the kids are all moved out, Elaine is building a bigger house in Lexington."

Eileen and **Edward Ringel** had a daughter, Meredith Fay, born a year ago September. He became head of respiratory medicine at the Mid-Maine Medical center in Waterville, Maine, moving from Chicago in December. . . . **Jay Krone** married Karen Vogt in August. Congratulations! . . . Hello to Jayne and **Ronald Todd**. . . . When I spoke with **David Sullivan's** wife Catherine, he was out campaigning for re-election to the Cambridge City Council. That was in October. I think **Sandy Yulke** told me at her Christmas party that he had won. This is how rumors start, though. . . . **Steve Cucchiaro** has founded, along with two others, Datest, Inc., developing information products for distribution on compact disks (CD-ROMs). He is assuming the position of president.

Robert Lyle Roth writes on the back of his Alumni Fund envelope that he is assistant professor of mathematics and computer science at Emory University. He recently served a year as Emory's first basketball coach. . . . A new resident of the Washington, D.C. area is **David Aldrich**, who became an assistant vice-president of Science and Applications International Corp. . . . **Debbie and David Vogel** welcomed daughter Emily Deborah into the world in June. The three of them are now living in Westwood, Mass. David works for Intertech Engineering Associates, a consulting firm in Dedham.

A very short cryptic note arrived from **Martin Cohen**: "Second daughter on the way." . . . **Linda Perry** has been consulting full time on communications systems and chip design. Entrepreneurs, as you know, mind their own business. . . . **Robert Nance**, married last year, is a radiology resident at the University of Virginia. . . . **Sheldon Lowenthal** is vice-president of engineering at Telphi Systems, making telecommunications computers for the hospital market. . . . **Brenda Chinn Kurnik** and **Peter B. Kurnik** are now assistant professors in nephrology and cardiology (respectively) at Rutgers Medical School.

John Cone writes, "I'm still working for Baxter-Travenol Labs as a mechanical engineering section manager. I recently volunteered to become the M.I.T. educational counselor for western North Carolina and am getting a chance to meet quite a few talented students. The Blue Ridge Mountains are still as beautiful as ever."

News from Susan and **Richard Hartman** starts out B-A-B-Y: Leslie Ann, 7 pounds, 3 ounces, born in September. Richard has become more involved in the "alphabet soup" of medicine, becoming medical director of an "IPA" and passing his oral boards in obstetrics and gynecology. He invites all his SAE fraternity brothers to call, come by, and stay awhile if they're ever in the St. Louis area.

"I have recently been appointed National Office Manager for Computer Audit Research for Price Waterhouse, Canada," writes **Jerry Gaertner**. "I continue to lecture at McGill University and to speak around the country on computer security, strategic planning for data processing, and the impact of expert systems on business. I'm unmarried, but actively looking, and pursuing an elusive M.B.A. part-time."

I loved the note from **Steve Gaskin**. "I'm living in Cambridge, working for Information Resources, Inc., 'the fastest growing market research company in the cosmos.' My terminal and I are on extremely friendly terms these days (strictly platonic, mind you)."

Tying together the last of the news this month is a note from **Gary Raymond**. "I have formed a software company, Infopro, Inc., with two part-

ners which specializes in fourth generation business application software generators. We already have over 150 major clients in 16 countries. Never dreamed I would wind up in this business back in 1969 when Professor Adams first introduced me to the IBM 1130 to help with homework in his 'Modern Marvelous Mechanical Motions' course. Thanks M.I.T."

Write me that letter today.—Co-secretaries, **Lionel Goulet**, 21 Melville Ave., Dorchester, MA 02124; **Jim Gokhale**, 45 Hillcrest St., Arlington, MA 02174

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Joseph Sorge is assistant professor at Scripps Clinic and Research Institute and has started a rapidly growing company, Vector Cloning Systems, which sells molecular biology products to laboratories worldwide. . . . **Jerald S. Feitelson** writes that after completing his Ph.D. in molecular genetics at Stanford University in 1981, he did a three-year N.I.H.-funded postdoctoral fellowship at the John Innes Institute in Norwich, England. He is now senior research microbiologist at Lederle Labs, where he's attempting to construct hybrid antibiotics using genetic engineering techniques. He married Eva Nagy in October, 1985.

. . . **William (Bill) Rowe** recently completed a three-year tour as an internist with the Air Force in Anchorage, Alaska, and has since returned to the "Lower 48" to do a fellowship in cardiology. Writes Bill, "The University of North Carolina at Chapel Hill marks quite a change for me: I love the academic stimulation but miss very much the snowy peaks, the glaciers, and the pristine wilderness of the North. If my fiancée has her way, it won't be too long before we return!" . . . **Arlo F. Weltge** has been board-certified in emergency medicine and was elected fellow of the American College of Emergency Physicians. He is vice-president of Southeast Texas Emergency Physicians and covers three hospitals in the southwest part of Houston.

Carol Livingstone has a new job. She is now head of the Division of Management Information at the University of Illinois at Urbana-Champaign. Her office provides data support services to administrators at the University. . . . **Charles J. Digate**, formerly director of international operations of Lotus Development Corp., Cambridge, Mass., is now vice-president and general manager of the international division. . . . **Alan B. Lefkof** is out there pitching, sales-wise. Asks Alan, "Anyone in the market for a high-performance computer system? If so, call Alan Lefkof, vice-president of marketing with GRID Systems Corp. in Mountain View, Calif." . . . **Charles U. Martel** is a computer science professor at the University of California at Davis. He has been married for three years and has a 13-year-old stepson. Writes Charles, "In my spare time, I have twice won the world championship in bridge: the pairs championship in 1982 and the Bermuda Bowl team championship in November, 1985."

Michael Kozinetz II is in Mt. Vernon, Ind., working on the construction of a plastics plant for G.E. He is still employed by Badger America and enjoying the stay in the "Heartland of America." He went to San Francisco/Stanford this past summer to attend classmate **Ross Shachter's** wedding. . . . **Paul R. Giguere** is in his tenth year with Camp Dresser and McKee at the Walnut Creek, Calif., office. Dan Leighton, '77, also works in the same office. On November 20, 1985, one of the Space Foundation's National Excellence Recognition awards for outstanding graduate research in a field related to space commercialization was presented to **Christopher B. Roberts**. He currently serves as the director of venture financing for the Center for Space Policy in Cambridge, Mass., and chief financial officer for Spacelab. Prior to joining the Center for Space Policy, he practiced law in New York City and worked as an electrical engineer at Raytheon. He recently got a master's from the Sloan School, where he did his

award-winning thesis on "Financing Commercial Ventures in Space."

I will close this column with excerpts from the mini-autobiography sent by **Thomas B. Higgins**: "Happily, my family and I are prospering in Houston. My wife of five years, the former Julie Hiatt of La Grande, Ore., makes a beautiful home for us and our two children, Benjamin, (2 1/2) and Julia (6 months). An accomplished pianist, Julie plays Granados when she wants me to relax and Bartok when she wants me to look lively. I've been with a structural engineering firm here (Haynes Whaley Associates) since 1977, and have pretty much completed the transition from architecture to engineering. My B.S.C.E. came in 1983 (University of Houston, nights) and my Professional Engineer's license ought to be in the mail around December, if I was lucky in the examination."

Professor J.J. Connor would be pleased to know that I have abandoned a lot of intuitive baggage about structures (as he once advised me to do) and have been known to read for pleasure on the topics of finite elements and dynamics of structures. Of course, I realize that this is a bit hard to imagine. From time to time I see Greg Turner, '74, the new author (I believe his book comes out in the spring). His architecture practice is picking up despite poor conditions here."—**Jennifer Gordon**, Secretary, 18 Montgomery Pl., Brooklyn, NY 11215

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10th Reunion

It is my sad duty to report the death of **Doreen Harris** (nee Getlan). Our sympathies go out to her husband, brother, and parents.

The mails have been bountiful. From **Steve Feld**: "I have been living in Israel for the past two years after finishing an internal medicine residency at Tufts (when I immigrated). . . . I have recently accepted a position as deputy director of the Respiratory Intensive Care Unit at Kaplan Hospital in Rehovot. Anyone interested can contact me there, telephone: 08-485-366." . . . From **Gail Walker** (nee Rubin): "On October 27, 1985, I married Edward Walker, a graduate student in computer science at M.I.T., working towards his Ph.D. We met two and a half years ago at M.I.T.'s Israeli folk dancing, which we still attend weekly. I sold my condo in Watertown and we bought a 74-year-old house in Belmont. Our wedding was in New York and we had a lot of M.I.T. people there, including, from our class: **Bill Anderson**, **Clark Baker**, **Arthur Gottlieb**, and **Rachel Morris Carey**."

And a very newsy letter from **Chris Roberts**: "On September 7, 1985 **Robert J. 'Bubba' Colten**, a brother of Lambda Chi Alpha, married Catherine Ann Hesz in Glen Ellyn, Ill. Despite intense heat and humidity, six brothers attended to solemnly witness the loss of yet another bachelor: **Roger Allison**, **Greg Hunter**, **Chris Roberts**, **Geoff Vining**, **Carsten Martensen**, and **Dave Dobos**, '77. Bubba has been working as senior financial analyst at Motorola in Schaumburg, Ill., since 1983; he joined Motorola in 1977. Catherine is an editor for a small book publishing firm." . . . **Roger Allison** and **Deborah** met while in the army stationed in Korea and were married in 1983. Roger left the army in 1984 and is a civil engineering consultant in Missouri, a job which has confirmed his low opinion of the legal profession. Deborah is still in the Army Transportation/Motor Pool Division. They are expecting their first child in December or January.

After graduation **Greg Hunter** moved to North Carolina where he spent his time teaching high school math at a Quaker school. There he met the woman of his dreams, Mim Wolf. Greg is presently coaching track and soccer at Manchester College where his wife attends chiropractic school. Greg and Mim were married in December 1984 in the Lambda Chi Alpha Fraternity house on Bay State Road. . . . **Chris Roberts** graduated from Sloan in June 1985 with an M.S. in manage-

ment and is working for the Center for Space Policy, Inc., a management consulting firm, specializing in government and commercial space programs. As director for venture financing, he is involved in business planning and raising financing for commercial space ventures. . . . **Carsten Mortensen** and his wife Julie, a 1980 graduate of the University of Kansas, were married in June 1982, and are now living outside of Kansas City, where they are active in the Flat Earth Society. Carsten is manager of operations for PDA, Inc., a software development firm. Julie works as a mechanical engineer for Kansas City Power and Light Co. Carsten and his brothers, Niels, '74, and Ken, '77, still mix it up in the Metro Hockey League of Kansas City.

Brother **Vining Geoff** is also married and the only attending brother with children (two). Geoff and his wife recently moved to Roanoke, Va., where Geoff will be attending Virginia Polytech in the Ph.D. program. Still unreconstructed, Geoff reports that the South has already risen but is keeping the information quiet so as to not alarm the Yankees. . . . **Dave Dobos**, '77, who was made an honorary member of the Class of 1976 for the occasion, entertained the guests with some impressive violin playing. Living in Columbus, Ohio, Dave is the division manager for direct marketing for Micro Electronics, Inc., the nation's largest independent retailer for microcomputer and related products. He stays active in local community affairs and serves on the M.I.T. Educational Council, interviewing prospective students for the Institute."

Douglas Hoon is now vice-president, advanced composite products manufacturing and marketing, of graphite fiber reinforced plastic structural hardware for aerospace and high-tech commercial users. . . . **Tom Downey** has moved to Bolt, Beranek, and Newman in Cambridge. He has also been spending a lot of time on his house, a 85-year-old Victorian. . . . **Robert Chen** and his wife, Meredith Golden spent two months in the P.R.C. last summer. They are currently winding up our doctoral programs at the University of North Carolina and expect to be in Austin this summer. . . . **Michael Chonoles** married to Susann Schoenberger (State University of New York, Albany, October 20, 1985. He's still working at G.E.'s Aerospace Group, Space Science Division, Military Data and Systems Organization, Ground Systems Programming Department, as a senior programmer/analyst. He says, "I've just won my third Professional Recognition Award for my contribution to G.E. All in all, I'm very happy. Regards to everyone." . . . **Burt Rubenstein** is now vice-president of research technology for Index Technology Corp., a Cambridge center-based two-year-old software firm. He and his wife, Kathy, had their first child, a boy, Nicholas, born in July."

Howard Tanzman has been named a manager in the management consulting department of Touche Ross and Co. in Chicago. He joined Touche Ross in 1979. He and his wife Rita (nee Korvac) live in Chicago. . . . **George Gazetas**, now a professor at Rensselaer, shared an American Society of Civil Engineers medal for the paper he co-authored, "Horizontal Response Piles in Layered Soils." The award consisted of a gold medal, duplicate bronze medal, and a certificate.

Barry Goldman writes, "Was recently promoted to manager in the management consulting division of Touche Ross. Also, I'm now helping to coordinate our advanced technology consulting nationwide. I'm still living in Fort Lee, N.J. and am in the process of selling my one-bedroom apartment and buying a two-bedroom in the same building. I don't think I'll be able to make the 10th reunion because I'm getting married on June 8 to Ms. Laurie Lewis of Chicago, whom I met last summer while spending two weeks in Israel on vacation. Laurie will relocate to New Jersey and should move from store management to a buyer position with Lord and Taylor, her current employer."

I have four lengthy letters from **Harry Lee**

Gearhart. From the most recent, December 1985, an excerpt: ". . . significant from my point of view was the pain in my leg I first noticed in July—a bad month. This was diagnosed at the end of August as a ruptured disk. After three weeks of bedrest proved fruitless, I checked into the hospital and let that well-known pair of neurosurgeons, 'Smilin Luke' and his tag-team partner, 'Dr. Imperious' work their magic on me. I am pleased to report that back surgery, while unpleasant, is nothing like Wierd Al Yankovic's video, 'Like a Surgeon'—the one with the chainsaw—would have one believe . . . in fact, Joanne (his wife) suffered more, as she was burdened with both an incapacitated husband and a healthy two-year-old. Fortunately, I can now help with Jeff (son) almost as much as before, a development applauded by all three of us; and my main surgical side effect is better posture. Still, I recommend almost any other way of spending a two-month 'vacation' from work. . . . Speaking of work, things are going well. I came back in late October to find our long-awaited scanning electron microscope had arrived. A nice piece of equipment; it's fun to show it off to folks around the company. I also came back to a promotion. I'm now a supervisor, with three technicians and our new grad engineer under my wing. Funny thing—I didn't feel like a boss until I brought in and prominently displayed my 'motivation enhancer'—a eight-foot bullwhip." My apologies to Lee that we cannot quote more, as he writes good letters.

Your secretary is looking for volunteer assistant secretaries to cover our 10th reunion. Rita and I will not be able to make it, alas, as we are expecting the birth of our child (first) at the same time. I can do arbitrage (New York, Boston), but I have my limits. However, I would like to state that I would like to run for another term as class secretary. Even after ten years—yes, that long—I still enjoy it very much. It is my hope that you will find I have served you well over the last ten years and will grant me the opportunity to continue. I want to thank all of you who have written, phoned, or visited through these ten years, for without you we certainly would have had less notes.—**Arthur J. Carp**, Secretary, 110-07 73rd Rd., Forest Hills, N.Y. 11375, (718)544-5136

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All right! We have lots of mail for a change, so here we go. **James Nixon III**, a project architect with a firm in Nyack, N.Y., as we last heard, was awaiting the results of the summer licensing exam. . . . **Kathy Roggenkamp** spent the 1984-85 school year as a high school computer education teacher, and currently is enjoying her work as a technical person in the marketing department of the SAS Institute, a software development firm in Cary, N.C. . . . **Dr. Nina Cahan** is in private practice, specializing in family practice and obstetrics. Nina became a fellow of the American Academy of Family Practice last October.

Andrew Werber is now an assistant professor of pharmacology and toxicology at Albany Medical College, and has received two National Institute of Health grants funding his research in cerebral circulation. . . . **Dr. Marc Levin** and his wife, **Dr. Deborah Rubin** are busy caring for their son, Robert Aaron Levin, born August 4, 1985. Both Marc and Deborah are in their second year of gastroenterology fellowships and are pursuing research interests in molecular biology at Washington University in St. Louis. . . . **Beth Ganister** got her M.B.A. about a year and a half ago, and then started her own business, Ganister Fields, Architects. The "Fields" is her husband, W.C. Fields. The firm handles houses, additions, hospital renovations, doctors offices, and even some work for M.I.T. . . . **Joseph Egan** is completing his final year at Columbia Law School. . . . **Charles Baltimore** is now president of the International Computer Exchange. . . . **Francisco Gardenas** is dean of PLURA, S.C., as a private

consultant. PLURA's activities include urban planning and architecture design, with the emphasis on ecological aspects.

Norman Speciner is the proud father of a one-year old girl, Lauren Joy. . . . **Dr. William Z. Cohen** graduated from the University of Maryland Medical School in 1981, did his post-graduate training at Parkland Hospital in Dallas, and is now settled in Houston, Tex. William has a busy family practice and is a member of the American Academy of Family Physicians. . . . **Mark Vincent** opened his fifth Computerland store in the Pittsburgh area last October. Mark and his wife, Marge, own 50 percent of the stores.

Michael Bleiweiss went on from M.I.T. to get his M.S. in applied physics at the University of California, San Diego. He then spent two years doing research in combustion and pollution control. Mike moved to Salem, Mass., where he does product development at Sylvania Corp. . . . **Samuel Gasster** received his Ph.D. in physics from the University of California, Berkeley, and is presently doing work in physical oceanography at Acete Assoc. in Sherman Oaks, Calif.

Mox Tan sent me a delightful letter in November, which I get to share here. After graduating from Harvard Law in 1984 and taking the New York bar exam, Mox ran away to spend: "three weeks sailing in Greece, three weeks adventuring in Egypt, two and a half weeks recuperating in Cyprus, four days relaxing in Sri Lanka, four weeks racing through India, one week sick in Nepal, ten days scuba diving and sailing in the Maldives, one week eating in Singapore, four days sight-seeing in Thailand, 15 hours in Hong Kong, eight days observing in Japan, and one week with old friends in California." Mox has now entered the world of ". . . greenmai . . . scorched earth tactics . . ." at Davis Polk and Wardwell in Manhattan, where he works on "proxy fights, hostile takeovers, and friendly deals," etc. Mox, it sounds wonderful; I think I'm jealous.

Deborah Stutman is still working in the Asphalt Technology Group at Owens-Corning in Granville, Ohio. Deborah plays softball and soccer in her free time and is getting to use lots of her academic background at work. . . . **Andre Au** moved to San Francisco in January and is still looking for a job as a project manager in real estate development in the Bay area. Feel free to get in touch if you have any leads. . . . **Dr. David Fox** recently moved to Ann Arbor, Mich., where he and his wife, Paula Bockenstedt, Wellesley '74, have joined the faculty of the University of Michigan Medical School. Their second child, Michelle Caroline, was born November 9, 1985, and Sharon will be four in January 1986.

Todd Glickman just completed a year as Chairman of the American Meteorological Society Board of Broadcast Meteorology, and was recently re-elected vice-president of the Technology Broadcasting Corp., the license holder of M.I.T.'s WMBR-FM. Todd will be entering an executive M.B.A. program part-time this year at Suffolk University, and we'll get to see if weather and business mix.

Tune in for more info. . . . Thank you ALL for writing!—**Barbara Wilson Crane**, Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

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From the military folks: **Mike Lazar** is still a lieutenant in the navy after three and a-half years as a F-14 radar intercept officer (RIO). So far, he has served in the Mediterranean and the Indian Ocean. He has flown missions over Grenada (during the invasion) and Lebanon, earning two medals. He's now on a three-year tour of the Pacific Missile Test Center as flight test RIO and project officer for some new weapons systems. On the more peaceful side, Mike just bought a house in Camarillo, Calif. and has married Martha Bruce Robertson of Virginia Beach, Va. . . . Also still in the service is **Al Mink**, who is working in the air force budget office in the Pentagon.

"A payload is very sensitive. It's like a baby that happens to weigh 27,000 pounds, is 15 feet wide and 20 feet long," says Captain Nanelle Scott Fulks, '78 (right), shuttle spacecraft test manager. She and a small group of other air force officers are preparing the facilities at Vandenberg Air Force Base, Calif., for Discovery's maiden flight.

Fulks spends about half of her 12- to 14-hour days at her desk. The rest of her time is spent at Shuttle Launch Complex Six, better known as SLICK-6. As launch date approaches, she will be spending increasingly more time at SLICK-6. "I have to ensure the satellite is going to function once the shuttle astronauts place it in orbit," she says.

The launch of Discovery, originally scheduled for March 1986 (now postponed), will represent the first West Coast shuttle launch. (Photo: U.S. Air Force by Walt Weible)



(No, he cannot get you a special low price on \$5,000 wrenches, so don't ask.) Al says, "USAF life is still great! Our five-month old daughter Jessica is a real jewel." . . . Curt Fennell left the Marine Corps last fall and moved back to Cambridge. Now he is doing program management consulting for John M. Cockerham and Assoc., Inc., in Lexington and keeping active in theater at M.I.T. and Wellesley.

Rob Milne writes, "I have enjoyed my year as chief scientist of the Army Artificial Intelligence, and my wife and I are looking forward to moving to Scotland to go into private business (my own)." Rob and his wife were expecting their second child this January. . . . Sheila Luster must have liked the air force quite a lot, because even after she quit she couldn't quit. She is working for the air force as a design civil engineer. She says, "Apple Valley, Calif. is high desert (meaning that vegetation is even more sparse than Tucson, Ariz.). My husband, Kevin Wade, '79, is still flying for the air force. We're only one and a-half hours from Los Angeles, so we should get to see many old M.I.T. friends."

News from our medical classmates: My old buddy, Julie Keller Pease, has moved back to Burlington, Vt. She is finishing her psychiatry residency, while her husband David is finishing his M.B.A. "We love it here (except for David's classes which are a bit of a drag)." They are enjoying the great outdoors of the great northeast, including cross country skiing, hiking, bicycling, and sailing. . . . Barbara Ostrov is completing her third year of medicine-pediatrics residency (she didn't say

where) and is planning to do a fellowship in rheumatology. In her words, "a perpetual student." . . . Raymond Dougal just completed his residency in internal medicine at the Mayo Graduate School of Medicine (Mayo Clinic), and now he will begin another residency in radiation oncology at Columbia-Presbyterian Medical Center in New York City. . . . Also, Michael Nathan will become a resident in internal medicine this summer after getting his M.D. from Rush Medical College in Chicago. And if I'm not mistaken, Jeff Snow is also a resident, although he didn't write about that. Jeff is living in isolated Albany, N.Y., and writes: "Wish to hear from some old friends."

Let's play geography, starting with the Californians. It seems Gary Cote has always been in San Diego, but now he writes that the end is near. "Publication and Ph.D. are both in sight at last, but not yet attained. For the future it looks like a post-doc on the East Coast. Free time spent putting together a collection of representative S. California flora before I leave this beautiful land. Can't beat New England, though." . . . Jack Lissauer recently moved to Santa Barbara to do research on the formation of the planets at the University of California. . . . Linda Couchon Rogers writes that she is the director of fiscal services for two small hospitals in southern California owned by AMI. Her husband, Hal Rogers, Ph.D. '78, is associate professor at California State University, Fullerton. They have been enjoying the fruits of their first "own garden" plot and throw an annual Halloween Party for the University's chem club (which

Hal advises), starring Hal's famous dry-ice punch. . . . Robin Newmark is enjoying life in the San Francisco Bay Area, while doing postdoctoral geothermal research at Lawrence Livermore National Labs. She and Fort Felker, '79, have been doing some rock climbing in the Sierras and even ran into some other alums in Yosemite last summer. . . . Keith Bennett has moved to Fountain Valley in southern California, after spending a year in Japan as a postdoctoral fellow with Nippon Schlumberger, K.K.

More geography; next stop—Massachusetts. Frank Murphy writes, "My wife Sharon and I decided to start a family. On May 25, 1985 our 'son,' Francis E. Murphy IV, was born—we call him I.V. for short, and short he is. Our 'son' is a Sheltie pup. He spends his days with me while I do my carpentry work. He loves to try to grab the hammer or saw while I'm using them. He's begun his schooling and, like his father, he is at the top of the class. Our next child will have two legs."

When Bob Bjorge wrote to me, he had just returned from a month's business trip to Ismailia, Egypt, where he tested a newly-installed power plant. "The week spent in Switzerland en route home was great—good weather in the Alps." Ah, but now Bob is back in Beantown (Revere), working for GE's steam turbine department in Lynn and teaching turbomachinery design at Northeastern University (for the second time). . . . A quick note from Bob Ledoux to announce the birth of his daughter Nicole Danielle last June. Bob was recently awarded the Cecil and Ida Green Career Development Faculty Chair at M.I.T.

From Jill Phelps Kern: "I am now working for Digital in Stow, Mass. as a management science consultant and am having a super time at it. I've been here a year now and still love poking around solving problems in the corners of the corporation. Dan Halbert also moved to Digital within weeks of me, and we've enjoyed sending electronic mail around the system. I'm also teaching operations research at Northeastern University at night and just gave my first for-money seminar in statistics for the American Society of Quality Control (I am currently chairman of the Human Resources Division). I'm glad to be back in New England—may I never have to leave it again!" . . . George Aronson's note tells us that he recently joined CSI Services, Inc., of Boston, consulting engineers and financial advisors to cities and countries that are building waste-to-energy plants. He writes, "So I'll be helping people to get their garbage out of the dumps."

I was wandering around in the Coop record section in Harvard Square just before Christmas, and, to my shock, looked up to see Milt Royce (buying a Keith Jarrett album). Milt and his wife Gloria came in from Detroit—well, Birmingham, to be precise, to visit his family in Boston. Both of them are Harvard M.B.A.'s working for competing car manufacturers—but I'm embarrassed to admit I can't remember which.

From Chicago: Dan Amidei finished his Ph.D. at Berkeley last June, with a long thesis on a very short subject, the lifetime of the I lepton. He's now at the University of Chicago, collaborating on a CDF detector at Fermilab. The goal: "proton anti-proton collisions at 2TeV (that's 3.2 ergs!) in the center of mass." . . . Jeff Rubenstein bought the farm—that is a real farm in Erieville, N.Y. Jeff is learning to drive a tractor when he isn't spending his time as vice-president of Engineering at Syracuse Telephone Co. (the non-wireline cellular operating company in Syracuse.)

Vermont: Skip Page and Debra Abbott Page wrote to us from Putney. Deb is doing architectural work for Lawrence Kasser Associates in Belows Falls, that is, when she isn't redesigning their antique home. Skip, who got his master's from Sloan two years ago, is working as a business analyst for Boise Cascade in Brattleboro, that is, when he isn't implementing the changes that Deb has designed for their home.

And for me? IHTFP—I Have Truly Found Paradise. I am now two months into my new job at University Hospital in Boston (affiliated with Bos-

ton University) and am greatly enjoying that fine institution of health care, research, and learning. I am a planning analyst, which is kind of like being an internal management consultant, working in the areas of marketing, planning, cost containment, and reimbursement. The work environment fits me very well, and I see lots of room for advancement. At the same time Yuko, my wife, has found some shade of paradise at, of all places, M.I.T. Yuko is a grad student at Sloan, and, when she isn't complaining about having to do too many problem sets, is loving (almost) every minute.

Hope your spring is warm and full of flowers. Write to me with news, gossip, hospital planning ideas and boring postcards at the address below.—**David S. Browne**, Secretary, 50 Follen St., No. 104, Cambridge, MA 02138, (617) 491-5313 at home, (617) 638-8915 at work.

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Susan Jane Colley reports, "All is well in Ohio. I have recently been awarded a Keck Fellowship in the Natural Sciences by Oberlin College. This gives me a semester's research leave next fall. I'll be studying 'the enumerative geometry of tetrahedra.' (Catchy title, no?)" . . . **Gail Kaiser** received her Ph.D. from Carnegie-Mellon University in August and is now an assistant professor of computer science at Columbia University. . . . **Michael Patrick** and Diane (Gorczyca) Patrick, '80, recently celebrated their first wedding anniversary and are "yupping it up in our condo in Inman Square." . . . **Bengt Muten** married Michele Austin on November 17, 1984, and moved to Washington, D.C., last January. He is employed by D.N.S. Associates, Inc. . . . **John Featherly** is "doing computer work for high-energy physicists at Brookhaven National Laboratory, which finally matches my VI and VIII degrees."

Michelle Robbin is doing a medical internship at Children's Hospital of San Francisco, and will begin a diagnostic radiology residency in July at U.C.S.F. Husband **Tim Kraft** is doing a postdoctoral fellowship on retinal physiology in Stanford's neurobiology department. They are enjoying the warm San Francisco weather after five years in Minnesota. . . . **Brian Wibecan** writes, "I am still working at Computer Information Systems in Braintree. I'm doing the operating system-level work for a performance monitor product for VAX computers. Close to finishing my master's degree at B.U. in the evenings. Computer science is great. After two career changes, I've found my calling!" . . . **Paul Thompson** moved to Dallas for a management job with Lone Star Steel Co. Paul reports that he and Becky are getting used to the south, and all visitors are welcome.

Emerson Knowles was made assistant vice-president of Shearson Lehman Brothers, Inc., last May. Emerson married Karen Hoving on November 27, 1981; daughter Courtney Elizabeth Knowles was born January 14, 1984. He writes, "Hope to see her in the Class of 2006!" . . . **Serge Chijioke** is currently involved in the design of house conversions in London and has "plans to operate in Nigeria in the pleasant weather there as well." . . . **Gerald Mata** is senior project management engineer in the Nuclear Organization of the Boston Edison Co. . . . **David Geiser** is senior process design engineer for Monsanto Agricultural Products Co. . . . **Kevin Wade** is flying for the Air Force and enjoying it. He's in Apple Valley, Calif. (George A.F.B.), learning to fly the F-4. He writes, "Where to from here, only the Air Force knows for sure! My wife, Sheila Luster, '78, is an Air Force design engineer here."

Richard Goldstein is an attorney and has just finished his first year working at Digital Equipment Corp. . . . **Michael Dymant** is president and C.E.O. for Starnau Corp. in Ottawa. . . . **Caren Kelman Edwards** had a busy year. She was mar-

ried and began as director of marketing for Custom Solution Inc., a computer software firm in Palo Alto, Calif.

I had the great pleasure of attending the wedding of my good friend Ken Turkewitz, '80 to Katie Robinson last December. We were at the "M.I.T. table," along with Nancy and Mitch Weiss, Janice and Wes Harper, Lori and Glen Taylor, '82 (he was the Best Man), Michael Greenwald, '80, and Tom Zaloum, '81. It was a lovely wedding and a good time was had by all.—**Sharon Lowenheim**, Secretary, 303 E. 83 St., Apt. 24F, New York, NY 10028

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Robert White and **Cathy Granai** were married October 6, 1984, in Hudson, Mass. They both work for DEC, Cathy for the Material and Technology Analysis Lab in Northboro, Mass. Robert has had a travel schedule that included England, Scotland, Japan, Taiwan, Hong Kong, and France, and now he's attending W.P.I. full-time (on DEC's nickel) to complete his M.S.E.E. He expects to be back to work in September unless he goes on for his Ph.D. . . . **Steven Glassman** writes that he and Miriam are celebrating two and a half years of marriage. "After some years of self-imposed exile in Nashua, N.H. with Sanders Associates, I'm back in Cambridge working for B.B.N. Communications."

Susan Wildin is a second-year resident in pediatrics at the University of Texas Medical Branch in Galveston. . . . **Carol M. Julin** is in graduate school at the University of Wisconsin at Madison, studying exercise physiology. She writes that she's still playing volleyball, singing, riding her bike everywhere (as everyone in Madison does), and living with an art student. . . . **Richard Barcant** is now happily married, has a 3-year-old daughter, two birds, and five windsurfers. He got his P.E. and is now working for Allan and Conrad in Orlando, Fla. . . . **Nolan Kagetsu** is a second-year radiology resident at St. Lukes-Roosevelt Hospital.

Tomas A. Gonzalez Laugier started a new division in his corporation, called Caremco, Inc. He'll be travelling to Japan, Europe, and South America to visit related operations. He says the weather is great, and sends "greetings to Bexleyites!" . . . **Timothy Winsky** is now a lieutenant in the navy (qualified submarines), working for the chief of naval technical training in Memphis, Tenn. He's in charge of submarine engineering training. He got married in September, 1984, and is thoroughly enjoying life with Kelly. . . . **Seanna (Friedman) Watson** is living near Ottawa, and has recently returned to work at Bell-Northern Research after having been on maternity leave with her son Trevyn, born on November 24, 1984. . . . **Chip Saltzman** is now a personnel consultant for engineers and technical personnel with Fox-Morris, Inc. He will be opening a Boston office next year. He lives with his wife and new daughter, Jennette, in Baltimore, Md.

Basil Safos writes, "Still actively burrowing the corporate minefield like a sightless mole. Am currently presiding over the Supreme Council of Loaches. We know who you are." . . . **Susan (Weil) Bates** is planning analyst at Lutheran General Hospital in Park Ridge, Ill., and lives in Hyde Park (Chicago). She is a half-time student at the University of Chicago School of Business. Her husband is at the Lutheran School of Theology in Chicago.

Cindy Reedy is "still suffering from a case of terminal thesis" with respect to her master's in bioengineering at the University of Washington. She is currently working at the Pacific Science Center as a science instructor. She is in charge of a travelling van program which delivers outreach instruction on Halley's comet: "Everyone is overworked, underpaid, and having a great time." In October, she married Brad Cummings at her parent's home and says it was great to have some

Baker Alumni there to celebrate with them.

Diane (Postetter) Collins resigned in January from Boeing, where she worked in sales and marketing, to take a new job in London in the corporate financial consulting group of Chase Manhattan, Ltd. She expects to do a fair amount of (mostly European) travel in this position. Her husband, Jack, will begin a three-year Ph.D. program in England studying Old Testament languages. . . . **Tim McManus** is doing very well consulting to Honeywell in Minneapolis and says that, contrary to a recent assertion in this column, he is very pleased to be a graduate of the Sloan School. . . . I saw **Pat Latterall** on a recent business trip to the Big Apple. He appears to be thriving in his job at Rothschild Ventures and says that New York isn't too bad. . . . I recently learned that **Barry Star** will be starting work as an associate at Index Systems, Inc., in Cambridge (where I now work).—**Kate Mulroney**, Secretary, 10 Arizona Terrace #3, Arlington, MA 02174

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Dave Surber is working for British Petroleum Alaska Exploration, doing reservoir simulation on the North Slope patch while working on an M.B.A. at the University of San Francisco. He says he is an "as-yet-unmarried, Porsche-driving, Cray-hacking, ski-bum Californian" and would recommend it to anyone. Dave has written in with news of many classmates: **Austin Puglisi** finished his master's at the University of Michigan, Ann Arbor, and is now back in the Boston area. . . . **Scot Goldberg** is in his last year of medical school at Wayne State University. He's likely to take an internship in the Boston area with "an eye to reattaching severed limbs, like M.I.T. students' heads after Ph.D. prelims." Scot says, "My advice is to start drinking heavily." . . . **John Schutkeker** is still at the 'tute, trying to invent the fusion reactor, and should be getting his course XXII master's any minute now. . . . Swimming star **Karen Klinciewicz** married another U.C. Berkeley graduate student a couple of years back. . . . **Judy Romann** is living in San Francisco, working for Morse Diesel on some new construction at Stanford University.

Suzanne Amador was married last summer to Philip Nelson. Suzanne and Phil are staying in Cambridge while Suzanne finishes her Ph.D. in applied physics. In attendance at the wedding were **Alison Schary** and **Lisa Lam**. . . . **Rainer Bruch** wrote to fill us in on his activities since graduating. Rainer worked as an assistant professor at Berlin Technical University and finished his Ph.D. in 1983. Thereafter, he briefly worked for Airbus Industrie, airframe manufacturer, and then became executive assistant to a board member of Standard Elektrik Lorenz A.G., a subsidiary of I.T.T., in Stuttgart, Germany. His business area is telecommunication export marketing and sales. . . . **Doug Borowski** is working hard at a startup company, Cybernex, in Silicon Valley. He's considering going back for more school, maybe an M.B.A.

Timm Anderson and **Lisa Ambrogio Anderson**, '83, live in Ithaca, N.Y. Timm works for Singer's Link Flight Simulation division in Binghamton. He says, "It's really neat—you can fly fighters and helicopters around and not worry about crashing." Lisa is in her fourth and final year of veterinary school at Cornell and comes home "smelling like horses and cows every night—MOO!" . . . **Grace Malloy** completed a ten-week bicycle trip from Boston to Seattle, via Denver and Glacier National Park. She says that, "like M.I.T., it's something I'm glad I've done, but you'd have to pay me a lot of money to do it again!" In Seattle, Grace visited **Steve Hazlerig** and his fiancée. . . . **John Hollis** is in his third year at veterinary school, learning to be a master surgeon/diagnostician and wondering about alternative careers like native guide. . . . **Eduardo Moas** is pursuing an M.S. at Virginia Polytechnic

Institute in dynamics. His wife, Michelle Hunt Moas, is working at Hayes, Seay, and Mattern, an architectural and engineering consulting company. They're both in love with Blacksburg, which is situated in the scenic Blue Ridge Mountains of West Virginia.

Jose Rodriguez is writing his Ph.D. thesis in condensed matter physics at the University of Illinois. He's also spending some time at Los Alamos, New Mexico, working on his thesis and learning to ski. . . . **Judy Badner** is in the second year of the M.D.-Ph.D. program at the University of Pittsburgh. She starts "Ph.D.ing" in population genetics next year. . . . **David Shapiro** is in his second year of a Ph.D. program in statistics at Stanford. He says, "Life is good out here!" . . . **Caroline Weber** is in her first year of the M.S. program in the I.L.R. school at Cornell. Her comment, "It's gorgeous, but it isn't Boston." . . . **Mark Kaplan** is in his second year at New York Medical College. . . . **Benson Margulies** is now working for Symbolics. . . . **Martin Carrera-Patino** is in graduate school at the University of Chicago. He was married last year to Elizabeth Lott in the M.I.T. Chapel.

Bryan Fortson was Air Force Materials Laboratory Company Grade Officer of the Quarter for the third quarter of 1985. . . . Post card of the month goes to **Gerard Weatherby** for his entry (the only entry) of St. Croix, where his submarine pulled in for four days. . . . **Michael V. Post** is also on a submarine. He's gone to several exotic ports. He's sunbathed on the fabulous beaches of Toulon's French Riviera, enjoyed a lively cabaret in downtown Paris, viewed the world from the stupendous heights of the Eiffel Tower, toured the ancient ruins of Pompeii, Naples, and Rome, and had dinner atop the renowned Rock of Gibraltar. He also won a small sum gambling at Monte Carlo and even rode a camel, overshadowed by the great pyramids of Egypt. He's winding down to the final stretch of his commitment to Uncle Sam, and will soon be delving into the brutal, fast-paced world of high technology as an ambitious civilian adventurer. . . . I'm enjoying the simple life of a student with my bike and my cat. I'm hoping to add a piano to the collection soon but have no plans for anything as drastic as children, a husband, or a television. Those will have to wait until I grow up, which fortunately does not appear imminent.—**Rhonda Peck**, Secretary, 11728 Mayfield Ave. #4, Los Angeles, CA 90049, (213) 820-0964

84

I have been rather busy of late, so I decided to take a break with this column. (So what else is new? Secretary Tu has been on vacation all year.) I was fortunate enough to have rectified a ready-to-print column from **Carolina Leonard**, who, upon submitting four pages of material, admonished: "I was getting quite upset because there was never anything in *Technology Review* about our class so I decided to do something about it. With the help of agents in the field—**Alex Guzen**, **Bob Polutchko**, and **Dennis Sacha**—I was able to compile the following information."

Pat Robertson is at Tufts Medical School. . . . **John Belzer** is at Yale Medical School specializing in windsurfing injuries. . . . **Ken Schull** is about to begin his Ph.D. at Cornell. . . . **Bruce Diaz** is on temporary assignment in various U.S. cities for Arthur Anderson, Inc. . . . **Jon Opalski** and **Kevin Mayer** are working for Remec in San Diego, "total mayhem, yeah-yeah, woo woo." . . . **Alan Orlo Powell** is at Duke Medical School. . . . **Eric Banks** is at Chemical Engineering Practice School, then on to Philadelphia. . . . **Tim Cooper** is working for Hughes and is leading the monastic life in Marina del Rey. . . . **Arnold Lee** spent one year at Yale Architecture School and is transferring to Harvard. . . . **Steve Lanzendorf** is taking the Boston financial world by storm and is engaged to Joan Yanofsky, Wellesley, '85. . . .

Bill Larkins is working in California for a small start-up electrical engineering company. . . .

Creag Trautman is in the air force on Florida's Gulf Coast and is reportedly going through the "Officer and a Gentleman syndrome."

Eric Gilbert is moving to Washington, D.C. to join a small consulting firm. . . . **Joe Pemberton** is moving to Pasadena with his new wife to start school at the University of California, Los Angeles. . . . **Heidi Brun** finished her master's at the Tute and has taken an extended trip to Israel before starting her job at Draper. . . . **Lauren De-Rosa** and **John Linton** are studying at Stanford. . . . **Laura Szynter** is living in Back Bay and working at New England Bio Labs. . . . **Suzanne Greene** is working for IBM in San Jose. . . . **Alex Guzen** says that he is "part of the Draper Lab crew who didn't have the guts or brains to get away from M.I.T." . . . **Kim-Wai Leong** is on a month-long vacation in Europe before he starts on his Ph.D. at the Tute. . . . **Katja Mamalakis** married Mark Sidel, '83, and is the proud mother of a baby boy!

Dennis Sacha finished up his master's and is on his way to join **John Einhorn** at Navy Flight School in Pensacola, Fl. . . . **Carl Adams** spent the summer traveling to Tahiti on an oceanographic research vessel and will continue working on his master's at Draper in the fall. . . . **Jeff Berner** got his master's in June, and he and **Ann Classen Berner** are reportedly looking for jobs. . . . **Neil Savasta** now works in marketing for Oracle Corp. in the Silicon Valley. . . . **Paul Bradford**, **Eric Monroe**, and **Mike Landmeir** all work for start-ups in the Silicon Valley and share an apartment in Mountainview. Big news—Paul has a girlfriend!

Vivian Wang is still with Hughes and is taking night courses at the University of Southern California. . . . **Cliff Bartlett** is stationed on the U.S.S. *Reed* in San Diego. . . . **John Halcomb** is on the U.S.S. *New Jersey* in Long Beach, Calif. . . . **Larry McKenna** was bored with the easy University of California, Los Angeles master's program, and the boring Los Angeles weather, so he transferred to M.I.T. . . . **Jeff Yoon** got his S.B. this spring and is working in Cambridge. . . . **Howard Reubenstein** made it 2,000 miles bicycling across the country (drove back) and is now working on his Ph.D. . . . **Heidi Stefanyshin** is married to a navy lieutenant, and they are both going to Navy Diving School and then on to Hawaii.

Bob Polutchko is working at Draper Lab, windsurfing on the crystal clear Charles, living at the Delts for the summer before moving in with **Jim Ellard** on Marlborough Street in Back Bay. . . . **Jim Ellard** is continuing his pursuits at New England Bio Labs. Rumor has it that he took a road trip to Princeton, met Brooke Shields, and is now spending weekends in New Jersey. . . . **Mark Farley** is living in the San Francisco area, working for the Tandem Corp., and is presently dating a telephone operator. . . . **Ted Teitelman** is working for Eaton Semiconductor and is living in the Silicon Valley. . . . **Rob Freeman** is working for Boeing in Seattle. . . . **Todd "Boo Boo" Bayer** is in the Air Force near Los Angeles.

Brian McKeller moved to Philadelphia—future wedding bells, he pinned his girlfriend this July. . . . **Bill Lapoint** is living in Brookline with his new wife and sweetheart of four years, **Kathy Morrissey**, Simmons, '84. . . . **Tom Houghtby** is somewhere in the Boston area. . . . **Jim Allard** is working for Honeywell in Minnesota. . . . **Phil Tietbohl** joined Orbis and is presently flying around the world with **Steve Yoon** supporting a medical team demonstrating new techniques. . . . **Suzannah Wurgler** is working at the Genetics Institute in Cambridge. . . . **Kathy Takayama** is in graduate school at the State University of New York at Stonybrook.

Carolina closes her column: "As for me, I hope to be 'de-institutionalized' by June. Any rumors that a gorgeous, independently wealthy man has asked me to spend the rest of my life with him on his Caribbean island (with shopping trips to Europe on the side) are absolutely, completely,

and unfortunately false (at least at the time this letter was written). Disclaimer of the above: If any of the above column is wrong or incomplete, write *Peter* and tell him about it."

Many thanks to Ms. Leonard, who is a graduate student at our dear alma mater and who lived one floor above me when I was a resident of Ashdown. As for me (to borrow *Carolina's* words), I spent this past year as a graduate student in Course XX (formerly Food and Nutrition Science renamed Applied Biology because the professors grew tired of being referred to as "fruits and nuts" teachers). However, because of "disagreements" with my thesis advisor (who told me that I was "arrogant, antagonistic, and impossible to get along with"), I will be leaving without my master's. In short, without going into details, this past year has been perhaps the most traumatic year I can remember. On the other hand, on a positive note, I did well in my classes. . . . Keep those letters coming.—**Peter Tu**, Secretary, 259 Summer St., Somerville, MA 02143 (617) 628-3476

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Our first major class event: **Adrian Wang** and I had a party at his townhouse for classmates in the Bay Area. About 25 showed up, among them **Pat Jennings**, **Ken Conradt**, **Jon Gafni**, **Jim Lutz**, **Andy Weiss**, **Andy Berlin**, **Jeff Winner**, **Chris Wright**, **Carl Linde**, and **Moris Dovek**. I hope we'll have some activities in the Boston area in addition to more in California. If you have any ideas or are interested in organizing an event let me know. If you're in New York or New Jersey, **Lynne Harth** is the regional coordinator and is the one to contact regarding activities in those areas.

I have a correction to make which dates back a few months. **Max Hailperin** did receive a Fulbright scholarship and is in Munich, but he is not continuing his studies right now. He is working at the European computer-industry research center. He plans to return to the States to attend Stanford next year. . . . **Joyce Lee** has been having fun in Atlanta getting together with **Sarah Tandler** and others. Last November she spent Thanksgiving with **Carol Yao**, **Peter Tu**, '84, and others. . . . **Vince Young** checks in from Stanford Medical School, where he rooms with **Michael McConnell**, '83. Some other classmates at Stanford are **Ruth Fricker**, **Shelley Johnson**, and **Ante (Billy) Lundberg**. Vince claims there are plenty of M.I.T. alumni in the area; he's bumped into them as his Tae Kwon Do class, at Stanford football games, in stereo stores, and in the elevator of his apartment building. Two fellow A.T.O.s are also in California: **Tony Collins** is starting graduate school at U.C.L.A. in computer science, and **George Jacquette** is working for T.R.W. in San Diego.

I've heard through the grapevine that **Carl Pietrzak** is engaged to an M.I.T. woman. I always knew Carl had good taste. . . . **Alex Praszker** tells me that **Laura McReynolds** and he will be married in late August. **Laura** graduated from Simmons and is currently in Philadelphia. Alex is at Stanford and plans to graduate in June with a master's in mechanical engineering. . . . A couple of my good friends have also become engaged: **Tom Rucker**, '83, and **Libby Patterson**. Tom expects to graduate from Berkeley in June, 1987, with a Ph.D. in chemistry. Libby will graduate with a master's in computer science this June.

Ken Katz checks in from southern California, Antelope Valley to be precise, where **Robert Meyers**, **Gail Standish**, and he are serving at Edwards A.F.B. Ken and Gail are avionics flight test engineers, and Robert works for the rocket propulsion laboratory. Robert is buying a house in Lancaster, and Gail is living with her husband in the same city. Ken has been busy with his Theta Xi brothers in the area. In **Ho Kim**, **Haj Sano**, '82, and **Eric Fujii**, '82. In Ho is at U.S.C. studying E.E.—**Stephanie Scheidler**, Secretary, 2 Carver St., Apt. B, Somerville, MA 02143, (617) 629-2069

At high speeds—over 100 mph—energy use per mile is proportional to the square of the speed (top). But even so, a 120-mph train occupies a special place in the spectrum of

transportation options. Though not as fast as aircraft, such a train is faster and more economical per passenger mile than any competing form of transport (below).

rail would attract tourists, and no pictorial on Japan or France is complete without shots of the *Shinkansen* or the *TGV*. But the economic benefit can be determined only by those who are very familiar with the local economy.

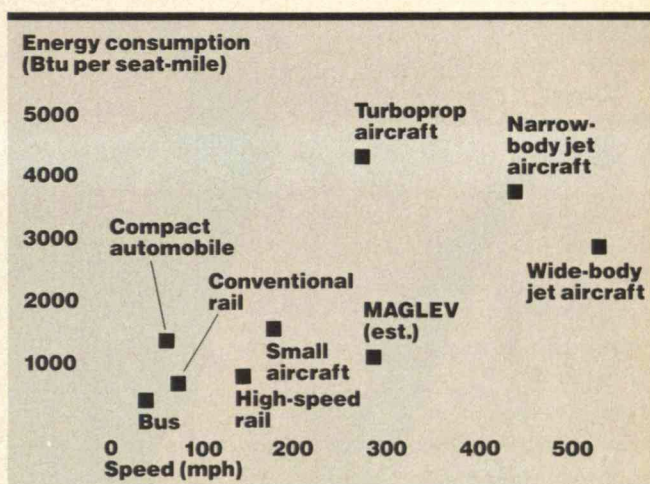
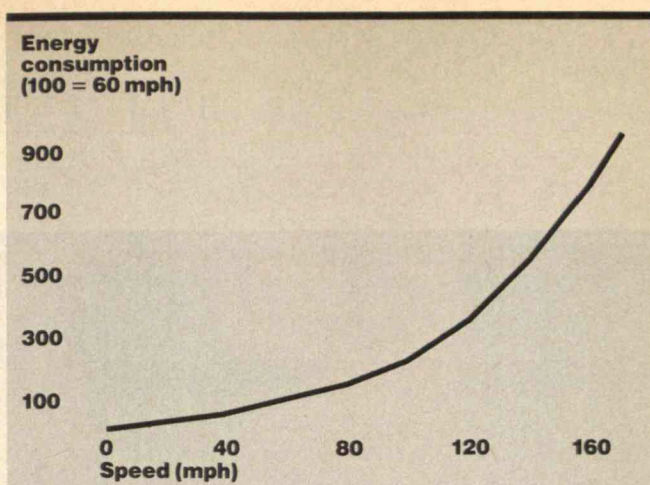
Some of the intangible economic factors of high-speed rail relate to effects on the transportation infrastructure, and such effects cannot easily be given monetary value. Consider, for example, the need for easy public access to high-speed rail stations. According to JNR estimates, up to 75 percent of *Shinkansen* riders reach and leave their trains by mass transit, presumably increasing mass-transit patronage. But in the United States, high-speed rail has not been able to take such mass-transit facilities for granted. Amtrak and the Federal Railroad Administration had to join with local communities in building parking lots to encourage use of the trains.

On the other hand, in some situations high-speed rail may save money by reducing the need for public investment in alternative transportation. One argument for the Los Angeles-to-San Diego high-speed line has been that trains will cut traffic on the overtaxed interstate highway between those points and thus eliminate the need for new highway construction. The same argument has been made in Florida, where major highways linking Miami, Orlando, and Tampa are forecast to be saturated by the turn of the century.

The Institutional Imperatives

All these issues bear on the answer to the ultimate questions: Who would want to build and operate a high-speed rail system in the United States and why? For whom are the benefits of high-speed rail service likely to be greater than the costs?

Building and operating a high-speed railroad will never be anything like a typical private-sector construction project with a specified client, known problems, and a given budget. Instead, high-speed rail systems are "mega-projects" in the sense that they have social as well as economic objectives. They affect virtually every economic and social activity in every community involved. They change lives, altering the way people use or perceive natural, cultural, and historical resources. Consequently, such projects are inevitable targets for conflicting political and social pressures. Indeed, no one can define in advance all the impacts of any particular high-speed rail proj-



ect and therefore all the institutional issues that will arise from it. The siting of stations and rights-of-way is likely to be controversial. Even schedules can be matters of public debate. Investors, engineers, and managers have to make social as well as technical judgments, taking responsibilities outside their professional fields and beyond their normal experience. High-speed rail systems simply cannot be built or operated unless all relevant public institutions are involved in some way.

In the final analysis, institutional issues will remain unresolved until the benefits received by each institution involved are roughly equal to or greater than the costs each incurs. Achieving this balance was no easy task even in Europe and Japan, where a central government has traditionally operated a centralized railroad system. A solution is still more difficult in the United States, where we have sought to maintain distinctions between the roles of the private sector and those of the various public-sector agencies.

The federal policy toward the high-speed rail systems now being proposed is very clear. Most high-speed systems would operate in one or at most two

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When Matt Meselson and his colleagues first announced their theory that the purported chemical-warfare agent known as "yellow rain" was actually the feces of honeybees, government officials dismissed their findings as "absurd."

PHOTOGRAPH: ENRICO FERORELLI/DOT

ONE SCIENTIST'S CRUSADE

A PORTRAIT OF MATTHEW MESELSON

LATE in the summer of 1970, Matthew Meselson, a molecular geneticist from Harvard, and John Constable, a plastic surgeon from Massachusetts General Hospital, arrived in Saigon to study the effects of the herbicide Agent Orange on crops and civilians in Vietnam. The U.S. Army had been spraying Agent Orange since 1963 to destroy the food supply of the Vietcong and strip them of cover in dense mountainous regions. The

American Association for the Advancement of Science (AAAS) had asked Meselson and Constable to conduct what amounted to the first full-scale scientific investigation of Agent Orange, and the army had agreed—at least informally—to cooperate.

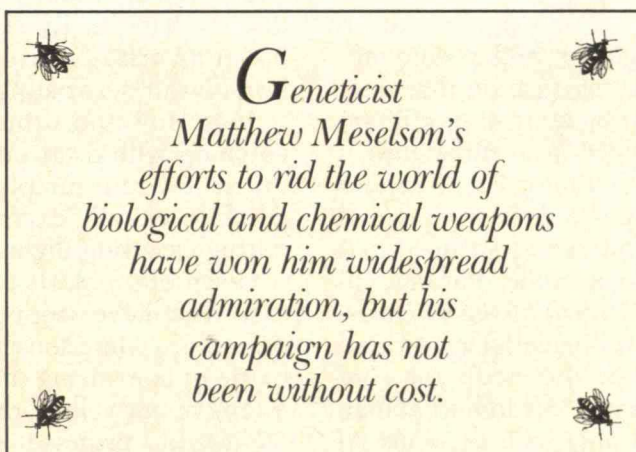
At one point, however, it looked as if the investigation would be aborted. After some initial work in Saigon, Meselson and Constable wanted to fly into the remote areas where the herbicide was actually being sprayed. But they couldn't find anyone—U.S. Army brass or Vietnamese—who would give them a helicopter.

Apparently, the word was out from Pentagon officials in Washington that Meselson and Constable were not to have a helicopter. Constable remembers thinking, Well, that's that.

But that wasn't what Meselson thought. According to Constable, he wangled an appointment with the colonel in charge of helicopters under General Rosson, then commander of U.S. troops in Saigon. "When that colonel told him, no, he couldn't give him a helicopter, Meselson

said, 'I understand, but we've come all this way and now we're up against it: the only way we can complete this study is with a helicopter and you're the only one who can give it to us.' " Meselson went on in that vein for a few more minutes, Constable recalls, and the colonel ended up giving the two scientists a helicopter—and a pilot who would fly it anywhere they wanted to go.

"Matt doesn't take no for an answer," says Constable, a British-born surgeon who was one of the first doctors allowed into Vietnam to study napalm burn victims. "He's extremely



BY ALISON B. BASS

persistent and persuasive."

When Meselson and Constable returned to the United States, they wrote up a report concluding that Agent Orange was damaging animal life and possibly people in Vietnam. Furthermore, they said, the herbicide spraying was not achieving the desired military results: if anything, it was helping the United States lose the war by giving the Vietcong a better view of American road convoys. The report made its way into the hands of then Secretary of State Henry Kissinger, and hours before the two scientists were scheduled to present the report publicly at an AAAS meeting on December 26, 1970, the Nixon administration announced that herbicide operations in Vietnam would be phased out.

Meselson won that battle with the bureaucrats in the Pentagon. And he won again when he—and others—convinced the Nixon administration that since live biological organisms were useless as military weapons, U.S. security would not be threatened if the United States signed the Biological Weapons Convention treaty outlawing the development and use of germ warfare. The United States signed that treaty in 1972 along with many other nations, including the Soviet Union. In *Disturbing the Universe*, Freeman Dyson, the famous mathematician and physicist, gives Meselson most of the credit for convincing Nixon to sign the treaty. "Seldom in human history has one man, armed only with the voice of reason, won so complete a victory," Dyson writes.

For the last four years, Meselson has been involved in yet another dispute with the U.S. government—this time over the true origin of "yellow rain." Yellow rain is the name given to a mysterious yellow substance found on leaves and bark in Southeast Asia, and collected by refugees fleeing the communist takeover of Laos during the late 1970s and early 1980s. The refugees were mostly members of the Hmong tribe who had fought the communists in a CIA-backed guerilla army. They said the yellow spots they had picked up were samples of a chemical agent that rained illness and death upon their remote mountain villages.

During the Carter administration, army chemists analyzed the yellow spots for all known chemical agents, including riot-control gas and mustard and nerve gas. They found nothing. Soon after President

Reagan began his first term, however, government officials announced that the mystery had been solved. In September 1981, Secretary of State Alexander Haig accused the Soviets and their communist allies in Laos of using mycotoxins, or fungal poisons. Such use would be a gross violation of the 1972 Biological Weapons Convention and the 1925 Geneva Protocol, which outlaws the use of chemical weapons. Both treaties would be violated because mycotoxins, while chemical in nature, are made by biological organisms—fungi. If the charge were true, it would be the first time that biological toxins had been used in the mass killing of civilians. As many in the Reagan administration saw it, the use of such lethal toxins would prove, beyond a shadow of a doubt, that the Russians could not be trusted to honor an arms-control treaty. Thus, there would be no point in negotiating or signing such a treaty.

Meselson and other scientists, however, have come up with a far different explanation: they say the yellow-rain samples turned in by Hmong refugees are actually excrement dropped by honeybees during cleansing flights over Laotian villages.

Given that reports of chemical warfare in Southeast Asia have stopped and that the evidence is drying up, Meselson may never win this particular battle of convincing the Reagan administration it is wrong about yellow rain. But many who know the 56-year-old professor say he will win the war and help rid the world of biological and chemical weapons. It is a mission he has zealously pursued for more than 20 years.

The Scientists' Conscience

At a national genetics conference held at Boston University last spring, Meselson, arriving late as usual, received loud applause from a packed audience of 200 colleagues as he stood up to speak about the molecular genetics of fruit flies. Sitting near the front of the lecture hall was a young biologist from Johns Hopkins University who confirmed my impression that the applause was for Meselson's stand on yellow rain, not for his relatively routine talk on how genes can be turned on and off inside fruit flies. According to this biologist, many scientists are frustrated by the Reagan administration's seeming unwillingness to consider sound scientific advice before launching into technologically absurd projects such as the Strategic Defense Initiative (SDI) and the campaign to

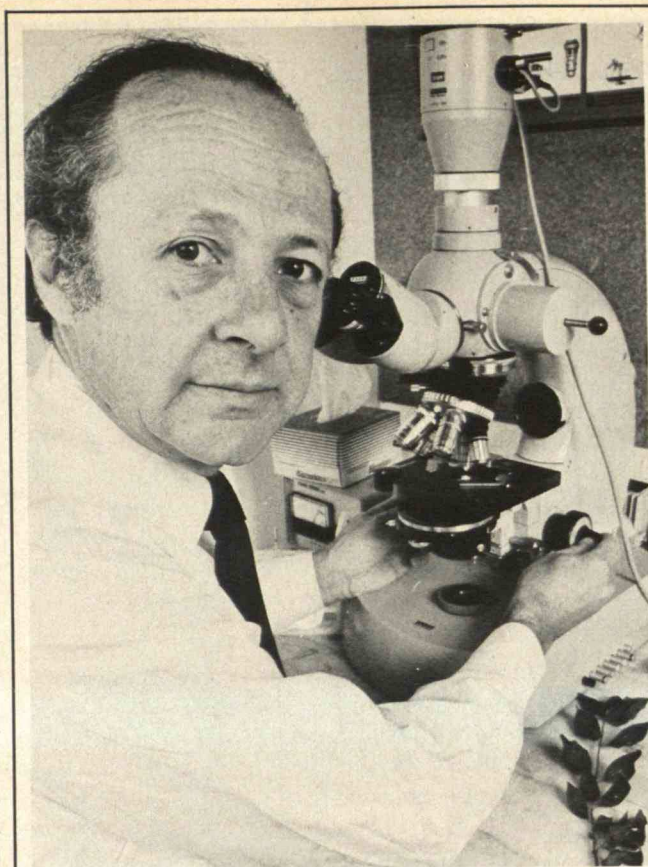
discredit Soviet compliance with chemical and biological weapons treaties.

These scientists regard Meselson with a kind of awe. They recognize that he is taking on the U.S. government—a task they have neither the time nor, more accurately, the inclination for. Meselson, whose scientific record is as impeccable as anyone's, seems to function as the scientists' conscience.

"Most people—and that includes scientists—allow others to do the leadership for them," says Peter Ashton, the jovial, red-faced director of Harvard's Arnold Arboretum, which has dried and filed away in drawers almost all of the 200,000 plant specimens in existence. "Matt is one of those few people who is willing to stand up and express a controversial view, not because it's controversial, but because it needs to be expressed."

Of course, Meselson's viewpoint is controversial. In its annual statement of Soviet treaty violations, the Reagan administration continues to assert that the Soviets waged illegal biological and chemical warfare in Southeast Asia from about 1977 to 1982. According to the administration, only adverse publicity about the attacks finally induced the Soviets and their allies to stop. Officials such as Deputy Under Secretary of the Army Amoretta Hober profess the highest regard for Meselson's abilities as a scientist. But Hober says that "Matt is not an expert on military policy and he does have an axe to grind."

The *Wall Street Journal*, which has championed the government's position on yellow rain in its editorial pages, has castigated Meselson as a "prominent scientist" who "wears no clothes." Stuart Schwartzstein, a foreign policy consultant for the U.S. government, has accused Meselson of "publicly



Mystified by the presence of pollen in synthetic chemical weapons, Meselson spent hours examining the samples of "yellow rain" found on leaves and bark by Laotian refugees.

embarrassing the United States government"; Schwartzstein, who until recently was associated with Tufts University's Institute of Foreign Policy, says Meselson should have voiced his doubts privately or not at all. And Joe Rosen, a biochemist at Rutgers University who reported finding mycotoxins in a yellow-rain sample he analyzed for ABC News, agrees. When asked what he thinks of Matt Meselson, Rosen says, "What I have to say you couldn't print."

A Singlemindedness of Purpose

At first meeting, Meselson hardly looks like someone who could arouse such harsh feelings. Softspoken with wavy, graying hair, keen brown eyes, and bifocals dangling from a black string around his starched collar, he seems

more like a character out of a Jane Austen novel than a central figure in the stormy waters of international politics. His third-floor office in the Fairchild Biological Sciences building at Harvard overlooks the green lawn and imposing red brick of the Harvard Yenching Library, whose shelves hold one of the largest collections of Chinese literature in the West. Next door to the Yenching Library is Harvard's massive Biological Laboratory, where Nobel Laureate Walter Gilbert and other scientists are probing the secrets of DNA, the basic genetic code of life. Next door to the Fairchild building itself is the Museum of Comparative Zoology, which houses an impressive collection of dinosaur bones, fossils and, of course, the endlessly intriguing ant colonies of sociobiologist E.O. Wilson.

Matthew Meselson is clearly at home amidst this pedagogical munificence, a gentleman professor who

numbers some of the world's top scholars among his friends. Even in these rarified circles, Meselson is described as "brilliant" and "quick-thinking," someone who has a "high moral code" and "all the characteristics of a great inquiring mind."

But beneath that quiet, almost Victorian calm, there is an unexpected intensity, a singlemindedness of purpose that often exasperates those who know him well. At times, being with Matthew Meselson is like being in the eye of a hurricane.

"He's very demanding. He's a perfectionist. Staples have to go in the paper a certain way," says Diane Baldwin, who worked as Meselson's secretary from 1982 until October of 1985. "I would know at times that he was upset about being late in getting a paper or grant proposal out. But he would never show it physically. There were times I wished he'd yell at me so I could yell back. But he never raised his voice to me, never."

Baldwin is now administrative officer for Harvard's Department of Cellular Biology, a significant step up from her previous job. Although obviously fond of her former boss, she acknowledges that he was a difficult man to work for. "He expects a helluva lot from people," Baldwin says. "It was very intense working for him."

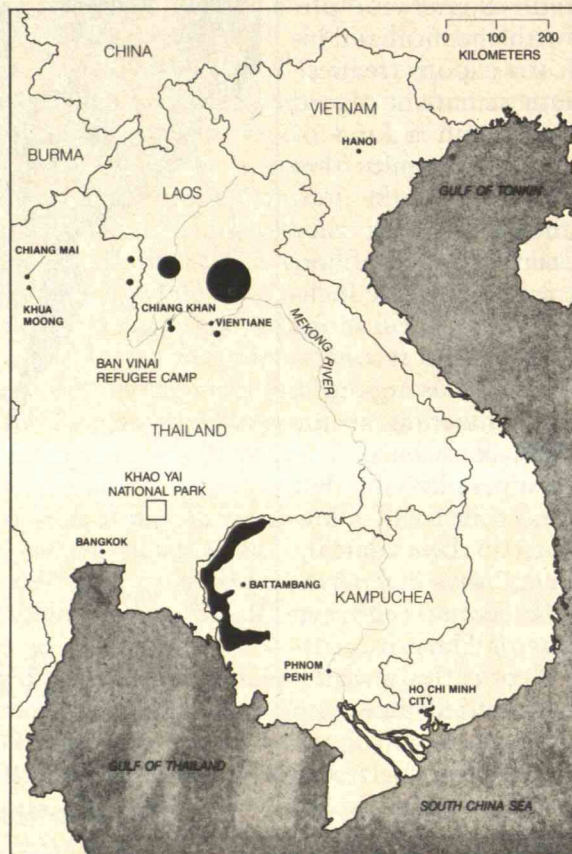
Baldwin, for instance, would work until 1 A.M. typing pages as Meselson and other scientists in the lab handed them to her. Often, Meselson would call her from his home a half-hour before his lecture and dictate the handouts for that day's class. "He expected me to have them transcribed, typed, and down in the classroom by the time the students came in," Baldwin recalls. Since she left Meselson's office, he has been through five different secretaries.

Tracking Down Yellow Rain

Until 1980, refugee tales of horror and death were the only persuasive evidence that the Soviets and their allies were waging chemical and biological warfare in Southeast Asia. In 1979, the Carter administration released a 130-page compendium of refugee testimony that included descriptions by Hmong refugees of yellow rain being sprayed onto their villages by aircraft. But the refugees also told of gas, smoke, agents delivered in bombs, artillery shells, mines, and hand grenades. And the agents they described came in a baffling range of colors: red, brown, green, blue, black, and white, as well as yellow.

To collect evidence for their theory, Tom Seeley, Meselson, and Pongthep Akkratanakul (shown here in front of the American Embassy in Bangkok) scoured Thailand in the spring of 1984. In the forest of Khao Yai National Park (below), the three

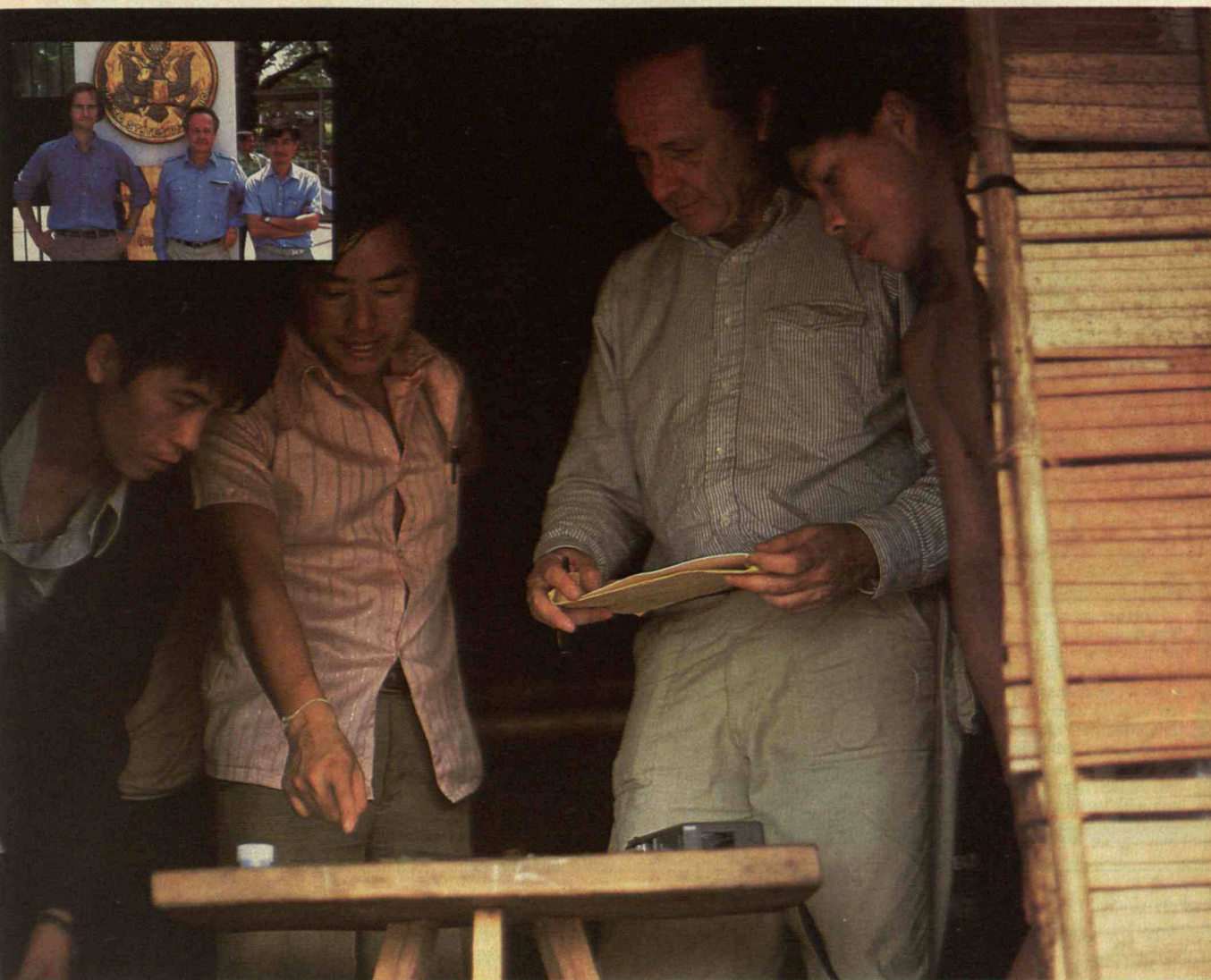
found bee feces that closely resembled yellow-rain samples. Meselson talked with Hmong refugees (right), who claimed yellow rain was evidence of chemical warfare. Dark areas on map indicate locations of alleged attacks.



According to one young Hmong refugee, more than 100 people became sick after two airplanes flew over his village, spraying yellow rain about 1,000 feet from the ground. Of these people, 20 to 30 reportedly experienced bloody diarrhea and vomiting and died a few days later. Other refugees also spoke of attacks that caused internal bleeding and sometimes death.

An army intelligence analyst named Sharon Watson was the first to connect these mysterious symptoms with those of poisoning from trichothecenes, a type of mycotoxin, or fungal toxin. This kind of poisoning had occurred before on a massive scale in humans, but the cause had been moldy grain, in which mycotoxins grow naturally. During World War II, for instance, thousands of Soviet peasants died from eating such grain. Watson hypothesized that the Soviets, realizing the potential of these poisons, had turned them into a lethal weapon.

Her theory received a significant boost when Chester Mirocha, a biochemist at the University of Min-



nesota, reported finding unusually large trace amounts of trichothecenes in a leaf sample of yellow rain he had analyzed for the army. Mirocha later reported finding mycotoxins in five more yellow-rain samples as well. Other than the sample Rosen had analyzed for ABC News, Mirocha's samples were the only ones reported to contain trichothecenes; the army itself analyzed about 60 samples and found nothing.

Meselson says he first became suspicious about the government's case while listening to the testimony of State Department officials at a Senate hearing in 1982. Richard Burt, then head of the State Department's Bureau of Political-Military Affairs, reported that a refugee carrying one water sample of yellow rain, collected from a pond near one alleged attack, had accidentally spilled the sample on himself. "As I understand it, he actually arrived in Thailand gravely ill . . . and contracted some of the symptoms that are connected with mycotoxins," Burt, now U.S. ambassador to West Germany, told

the assembled legislators.

Meselson was also there to testify at congressional request. He expressed a number of reservations about Burt's testimony when he reached the stand. He estimated that if the poisons were in pond water, a person of average weight would have to drink over 5 quarts of the solution before becoming "gravely ill." Furthermore, he said he doubted that mycotoxins released from aircraft in the form of particles or droplets would cause rapid hemorrhaging or death.

Finally, he pointed out that the experience with Agent Orange in Vietnam should have taught American officials that there is often a discrepancy between what rural villagers say and what actually happens. The tales of widespread illness and death reported by the Hmong refugees were similar to those reported by Vietnamese whose highland villages had been sprayed with herbicides by the U.S. Air Force. But at that time, U.S. officials thought Agent Orange posed no hazard to human health; there is certainly no evidence that it brings immediate



Similar to giant Asian bees (inset), Southeast Asian honeybees make mass cleansing flights that leave a swath of yellow fecal spots on vegetation (right). Close up, those spots (A) are indistinguishable from the samples of yellow rain (B).

Pollen grains make up the bulk of material both in yellow-rain deposits and in bee feces. The scanning electron micrograph (top far right) shows pollen in the sample of yellow rain from Laos obtained by ABC News. The map identifies the different types of pollen shown in the photo.

illness and death in its wake.

Despite his testimony, however, Meselson did not become actively interested in the yellow-rain issue until State Department officials announced that the samples contained pollen, the type that comes from plants pollinated by bees. "I immediately got some yellow-rain samples from the army and from Canada to look at," Meselson says. "That's when I went down to the Smithsonian and introduced myself to Dr. Joan Nowicke, their pollen expert."

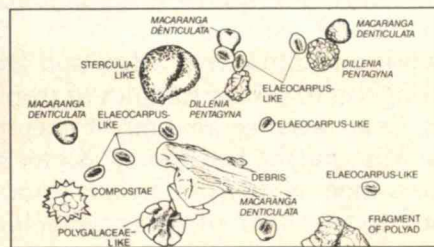
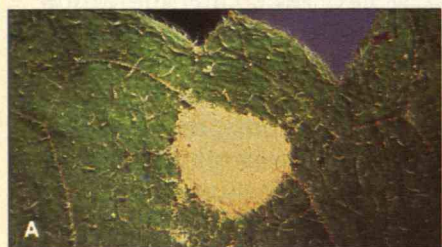
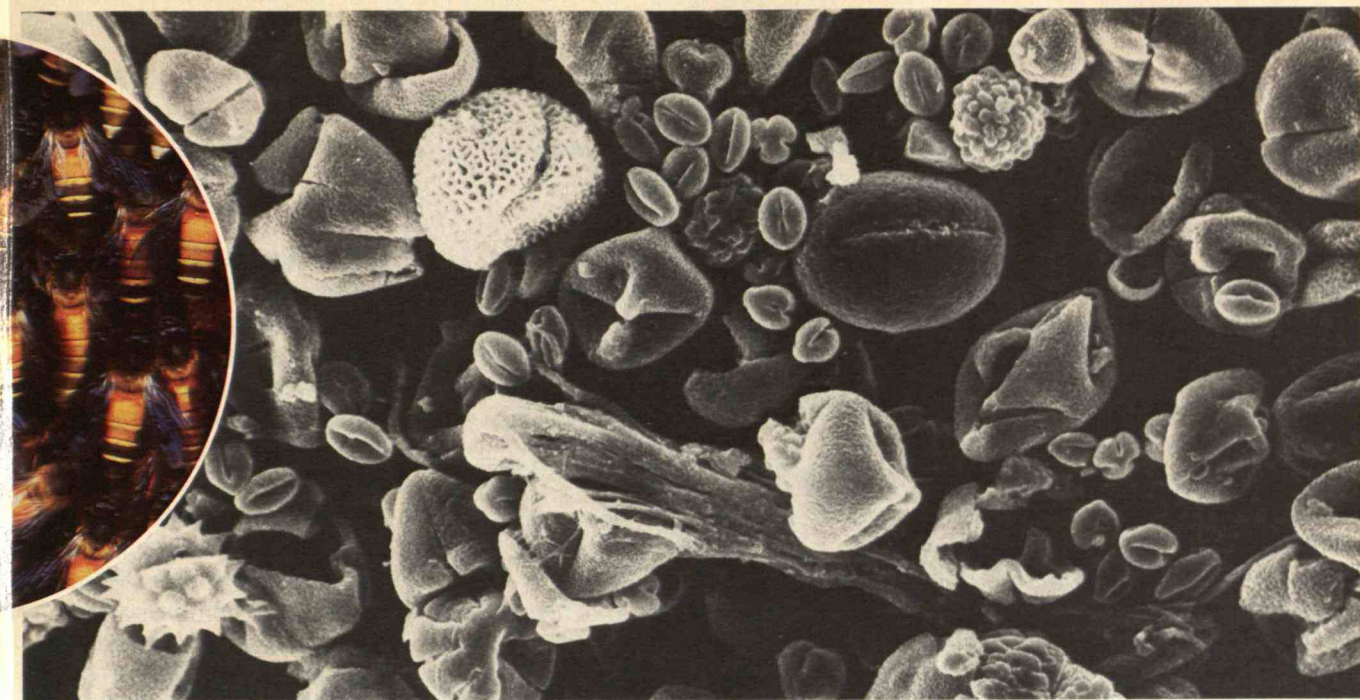
Anxious to find out why presumably synthetic chemical weapons contained so much caked pollen, army officials had already asked Nowicke to analyze some yellow-rain samples. "They were hoping to find distinctive pollen from plants that came only from the Soviet Union," Nowicke recalls, comfortably sprawled in an armchair in her cluttered office at the Smithsonian. "But I found that the pollen came from plants that are local to Southeast Asia."

Nowicke says she believed the government's case until she had thoroughly analyzed the pollen grains. "You go where your evidence leads you. In every yellow-rain sample where they looked for pollen, they found it. Now why would Russia go to the enormous trouble of getting pollen and then contaminating it with mycotoxins?"

Nowicke says government officials exerted "some pressure" on her to stop working with Meselson. But even though the Smithsonian is a federally funded institute, she was never directly ordered to stop. "A place like this bends over backwards when it comes to academic freedom," Nowicke says.

In April of 1983, Meselson, Nowicke, Ashton, and other scientists skeptical of the government's case met with state and army officials in an all-day "brainstorming" session organized by Meselson, Tufts University's Schwartzstein, and Carl Kaysen, director of M.I.T.'s Program in Science, Technology, and Society. At that Cambridge workshop, Ashton remarked that perhaps the pollen had been ingested by bees, who then regurgitated it onto leaves.

"I could see that it was something to do with bees, but I just wasn't thinking bee shit," remembers Ashton, whom Meselson had enlisted because of his expertise in tropical plant and insect life. "The following morning, I suggested that we ought to call Tom Seeley—he's really the expert on honeybees—and ask him what he thought." With Meselson by his side, Ashton did call Seeley, an entomologist at Yale University, and described the disputed samples in some technical detail. Seeley immediately said the samples sounded like bee feces.



The minute Ashton hung up, Meselson excitedly reminded him of the honeybee hives on the roof of the Museum of Comparative Zoology and suggested they check the surrounding parking lot for bee droppings. It was spring—the time when honeybees emerge from hibernation. Meselson got his whole lab involved in the search.

“I felt kind of silly going out with a plastic bag looking for yellow spots,” Baldwin says. “But when Professor Meselson found the spots on some car windshields, it was really exciting.”

After that discovery, Meselson was on the phone to Seeley for hours at a time, pumping him for information about the defecation habits of honeybees. Seeley informed him that bees in the tropics also conduct periodic “cleansing” flights. “In the tropics, honeybees form a protective, many-layered curtain around the nest with their own bodies,” Seeley explains. “They eat food and generate heat and all the time they’re building up feces. But when they defecate, they don’t do it one at a time. Instead they all leave at once, fly around for a few minutes and then reassemble the curtain. I think one reason they do it that way is that it’s hard for any one bee to work her out way of the multiple layers without breaking down the whole system.”

Facing the Flack

When Meselson first voiced his doubts about yellow rain, he was a consultant to the U.S. government on chemical and biological weapons, and had been since the Kennedy years in the early 1960s. Shortly after he went public with those doubts—in an ABC News interview in 1982—the CIA canceled his invitation to come to Washington for a briefing on yellow rain. His consulting contract with the Office of Management and Budget was also not renewed.

But the attacks began in earnest in May 1983, when he and Seeley announced the bee-feces hypothesis at the annual AAAS meeting in Detroit. In an editorial, the *Wall Street Journal* declared, “Continued insistence this week by Harvard’s Matthew Meselson that mycotoxin residues in attack areas are actually only bee droppings is too ludicrous for serious discussion.”

In fact, Meselson and Seeley had not made that claim. They had merely pointed out that the yellow-rain samples they had obtained from the U.S. and Canadian governments were bee feces, with no toxins. They were careful to note that the reported presence of mycotoxins in a few yellow-rain samples remained unexplained.

The criticism, however, only made Meselson more determined to prove his case. "The more he felt things were against him, the more those editorials in the *Wall Street Journal* came out, the harder he worked," Baldwin recalls. "He felt he had to go to Thailand to prove the bee-feces theory himself."

And so in the spring of 1984, using money from a MacArthur Foundation grant he had received for his work on yellow rain, Meselson left with Seeley for Bangkok to collect samples of tropical bee droppings. "Our average amount of sleep per night was about four, maybe five hours," Seeley says, thinking back to their whirlwind 10-day trip. "Matt really pushed to the limit of what we could realistically do."

Seeley, a tall, quiet man in his early thirties, bears a resemblance to the stern Yankee missionaries who made their way to Asia to convert the heathens. Yet he speaks of Meselson with the affection that a younger man might have for his more established—and more eccentric—older brother.

"Matt never loses his cool," Seeley says. "Well, I guess there was one time he kind of lost his cool while we were in Thailand. One night we were walking through the woods—it was more like a jungle—and I imitated a snake." But even then Meselson remained more composed than most American urbanites would have. "He just said something like 'That wasn't necessary' in a sharp voice," Seeley chuckles. "He knew right away it wasn't a real cobra."

A few days later, the two scientists were caught in a sudden shower of bee feces while photographing a nest of honeybees near a rural Thai village. Meselson didn't even get excited, according to Seeley; he was too busy collecting fresh bee droppings.

"Matt is really hard-nosed about the evidence," Seeley says. "Some people like to get an answer and stay with it. But not Matt. He keeps bearing down on his own analysis. There are many ways the bee hypothesis could have failed on closer scrutiny. For instance, if the yellow-rain spots happened to have an average diameter of six millimeters instead of

*Soul, o my soul,
you're beaten down with trouble.
Lift your chin and fight back
against whatever torments you,
overwhelming their ambushes
and fronting bad luck toe-to-toe.*

*But don't go bragging if you win,
and if you lose, don't lie down
sniveling at home.*

*Don't glory
too much in the good things, or mope
over the bad.*

*Remember
how chancey it is to be a man.*

ARCHILOCHOS
CIRCA 7TH CENTURY B.C.

three, there's no way they could have been produced by bee feces. But the bee-feces spots exactly matched the yellow-rain spots: they were both three millimeters in diameter."

A Whiz Kid's Worldview

Growing up in Los Angeles, the only child of a Jewish insurance salesman and a homemaker, Meselson gave little early indication of his interest in interna-

tional politics. He did, however, discover his other vocation at a young age. "I knew from the very beginning that I wanted to be scientist, that I wanted to apply what I thought of then as physics to the problems of life," Meselson tells me one afternoon, as we are sitting in the immaculate kitchen of his home.

Meselson lives in a small, charming duplex in North Cambridge. Every cushion in the downstairs living room is in place, and there are no books or magazines scattered around. Even though he is working at home this afternoon, Meselson is dressed in a white pin-striped shirt and an elegant brown wool suit; a neatly folded white handkerchief peeks out of his coat pocket. Meselson shares the duplex with his two teenage daughters for several days each week; he is separated from his second wife.

"I had a big laboratory in the basement of my house by the time I was in sixth grade," Meselson recalls. "By high school, it occupied the entire basement." In his basement kingdom, Meselson learned how to purify the rare earth elements: "They have such pure colors and spectral lines, but you can't find these elements in nature, they're too reactive." In between such experiments, Meselson and a few junior-high friends dabbled in building bombs. He recalls with a certain amount of nostalgia trying to detonate one particularly large explosive packed with homemade dynamite: "We took it to a big park and dug a deep hole and then ran the wires over to our trench. That was the one time I remember feeling very . . . well, exhilarated and at the same time afraid. But it didn't work, we could never get it to work."

*As a 16-year-old
“whiz kid” at the University of Chicago,
Meselson developed a lifelong affection
for the earliest Greek poets.*

Despite these diversions, Meselson managed to complete all his high school requirements—with the exception of physical education—in a year and a half. Impatient even then with inflexible bureaucracies—in this case, the school officials who wouldn’t waive his phys ed requirement—Meselson decided not to wait around for his high school diploma. At the age of 16, he enrolled in the University of Chicago, which had a special program for precocious teenagers like him.

It was there that Meselson first became aware of and indeed captivated by the larger world of international politics and history. “The method of teaching at the University of Chicago was to read original works and try to impart to students an impression of how we got to where we are today in our civilization,” Meselson says. “We started by reading the ancient Greek classics. This had the effect of imbuing us with strong feelings about the people in the text. You could almost feel you were Socrates arguing with someone in the dialogues. There was an enormous amount of intellectual debate and discussion, and it applied as much to the Greek philosophers as it later did to Marx and Freud and Dewey.”

Meselson developed a special affection for the earliest Greek writers: Homer; Archilochos, a mercenary soldier and poet—“an angry man who talked of throwing away his sword”; and Sappho, the famous woman poet who, as the legend goes, ran a school for young Greek maidens on the island of Lesbos. “There’s a freshness and directness in these early Greek writers that’s very special,” Meselson explains.

The University of Chicago students themselves were an unusual mix: many were whiz kids like Meselson impatient to get a look at the world, and many were GIs returning from a hard-won victory in World War II. “To us, the veterans represented all kinds of hands-on experience with the real world. They had girl friends, they had shot at people, they’d been shot at, they had stories to tell. We got along just super.”

The worldview of these GIs exerted a powerful influence on the impressionable 16-year-old kid from L.A. “They brought with them the feeling that the war had been fought to get rid of an unspeakably evil enemy and now a new dawn would arise. Now mankind was going to create the good life, an unprecedented era in which our intellectual and moral energies would be released in a way that had never

been witnessed before.”

Meselson pauses, deep in memory. And then he sighs, almost inaudibly, and his voice goes flat: “It didn’t happen of course.”

The Right Activity for a Young Man

After graduating from the University of Chicago and spending a leisurely year traveling through Europe, Meselson returned to California to become a graduate student under Linus Pauling at Caltech. By then, Pauling had won his Nobel Prize for chemistry and was working to bolster support for a nuclear test-ban treaty, for which he would later earn the Nobel Peace Prize.

Yet Pauling, ironically, did his best to discourage his young graduate student from dabbling in political matters. “At one point [in the mid 1950s], a colleague and I tried to organize a scientific conference on the biological consequences of nuclear fallout,” Meselson remembers. “It’s hard to believe, but in those days that subject was taboo. And to our astonishment, we couldn’t find a hall for the conference. We’d rent a hall, we’d make up a guest list, and then someone would come along and deny us the right to use the hall. This happened a number of times, and it was taking a lot of time away from my graduate studies.

“Well, finally, Linus approached me about this—it was late at night in the chemistry building—and he said, ‘Matt, I’d like to talk you, let’s go to my office.’ And then he told me two stories. One was about Socrates. He said Socrates was once asked, ‘What’s the right activity for an old man?’ And Socrates said, ‘Politics.’ And then he was asked what’s the right activity for a young man? And Socrates said, ‘Science.’ And then Linus sort of looked at me over the rim of his glasses”—and here Meselson demonstrates with his own bifocals the way Pauling looked at him 30 years ago—“to make sure I got the point.

“Then he said my second story is about the German mathematician Carl Gauss. When Gauss was 12 years old, someone asked him, ‘Gauss, why are you such a great mathematician?’ And Gauss said, ‘I don’t know, maybe it’s because I never do anything else.’ ”

After that brief conversation, Meselson dropped his plan for a conference on nuclear fallout and went back to work on his doctoral thesis. A year after he

*Linus Pauling did his best
to discourage Meselson, then a young graduate
student, from dabbling in political matters.*

received his doctorate, he and a colleague, Frank Stahl, proved that the DNA double helix replicates by coming apart into two nucleotide chains, each of which makes a complementary chain to form another double helix. James Watson and Francis Crick had already proposed that model of replication, but they hadn't demonstrated its accuracy—and scientists had advanced other unsubstantiated theories as well. Once biologists really understood how DNA replicates, they could begin to examine the crucial replication process in living cells.

The Meselson-Stahl experiment, as it is known today, is "one of the seminal experiments in modern biology," says David Baltimore, a Nobel laureate biologist at M.I.T. and director of the Whitehead Institute for Biomedical Research. "Matt should have won the Nobel Prize for that experiment. When he came onto the Harvard faculty a few years after that, he was *the* bright young man of contemporary molecular biology."

At Harvard, Meselson continued to take Pauling's advice and explore the frontiers of molecular genetics. But in 1963, he was unexpectedly offered a summer job at the fledgling Arms Control and Disarmament Agency (ACDA) in Washington. The job offer was arranged through Paul Doty, a Harvard professor who was then on President Kennedy's science advisory commission.

"Everyone in Cambridge got offered jobs during the Kennedy years," Meselson says. "The joke was that the shuttle for Washington left from Harvard every two hours. That was quite a time."

Meselson's office-mate at the ACDA was Freeman Dyson, who was studying nuclear arms control. At first Meselson was also assigned to study nuclear weapons, but he soon asked to be reassigned to an area he knew something about—biological and chemical weapons. After receiving top security clearance, Meselson began reading all the classified and declassified material he could find on the subject.

During his research that summer, Meselson came across Army Field Manual 3-10—the document that almost singlehandedly convinced him that the world was better off without biological weapons, even as deterrents. "This manual contained actual operating-type guidance for how to deliver biological agents over hundreds of kilometers to kill vast populations," Meselson says. "And it wasn't even classified."

Meselson couldn't believe that high-ranking army

officials would allow the open publication of a manual that would easily convince other nations that the United States was seriously interested in biological warfare. After all, such nations might react by embarking on their own biological-warfare programs. At the end of his summer at ACDA, Meselson wrote a classified paper for the White House. It said that the army's biological and chemical weapons program was "dangerously unsupervised" and that it was "foolish" for a wealthy nation with an interest in law and order to do anything to stimulate germ warfare. He concluded that the United States, already well equipped with nuclear arms, did not need biological and chemical weapons and should immediately destroy its existing stockpile of those arms.

Five years later, after more such reports from Meselson and others, President Nixon did decide unilaterally to destroy the nation's stockpile of germ weapons. He also decided not to build any more chemical weapons, though he did not authorize the destruction of existing chemical munitions.

"This was Nixon's finest hour," says Dyson in *Disturbing the Universe*. In Meselson's eyes, however, the victory will not be complete until the United States and other nations, particularly the Soviet Union, destroy their stockpile of chemical weapons and outlaw the development of new ones. For that reason, he has fought against the production of the new chemical binary, or two-stage, weapons advocated by the Pentagon. Last summer, Congress authorized \$150 million for these new weapons, but production has not yet begun.

An International Dilemma

Meselson believes that the Reagan administration's support of binary-weapons production and its continued assertions of Soviet chemical warfare in Southeast Asia jeopardize any chance of a comprehensive chemical-weapons treaty. For many in the U.S. government, he says, the real objective of the yellow-rain affair is to halt all treaty negotiations with the Soviet Union. "If you look at the statement from the President every year in which he cites the treaty violations of the Soviets, there's always at least five violations and the first one is the biological warfare violation," Meselson notes. "The other four are technical violations: violations at the edge of agreements that lawyers can argue over. But yellow rain is a brutal, cynical, absolutely unquestionable vio-

lation if it's true. If it's true, a lot of people would feel there's no sense in talking to the Soviets at all. But if yellow rain turned out be wrong, then all they'd have is a bunch of lawyers' briefs."

Bill Kucewicz, who has written most of the *Wall Street Journal's* editorial-page articles on yellow rain, readily acknowledges that he is trying to discredit the Soviets. "I would take the tack that the administration hasn't been forceful enough in accusing the Soviets of violations," says Kucewicz. "We shouldn't be entering into any new treaties with the Soviet Union until we clarify the violations of the existing treaties, and I'm not sure that can be done. I don't think you are likely to see any meaningful arms-control agreement with the Soviet Union until they change the way they run their society—until they become a more open society."

Kucewicz is very candid about why the *Wall Street Journal* supports the government's position on yellow rain and attacks those who do not: "At the time of the Haig announcement, the press had front-page stories on yellow rain. And then it seemed to get dropped and put on the back burner by most of the media. And some people in government—in the administration—contacted us and said, 'Gee, can't you guys keep this going because it is a vital issue.' After we saw how extensive this was and what it meant for the future of arms control and how inhumane these types of weapons were, we decided to take this on as a cause."

Kucewicz echoes government authorities such as the State Department's Col. David Lambert who believe that yellow rain is more than just a scientific problem. To them, it is a thorny international dilemma that involves human suffering and governmental wrongdoing. "When you're living in the real world and not in the scientific world, you have to make certain decisions with the evidence you have," Kucewicz says. "You can't apply strict scientific stan-



In 1960, biologists François Jacob and Sydney Brenner proved the existence of messenger RNA, which carries the instructions of DNA, the basic chemical code of life, in each cell. Matt Meselson helped them with that experiment.

From left, Jacob, the well-known biologist Max Delbruck, Meselson, and biologists Ronald Rolfe (obscured), Gunther Stent, and Brenner in Delbruck's garden in Pasadena, Calif., at the time of the RNA experiments.

dards to the problem of yellow rain."

Kucewicz argues that the U.S. government accused the Soviets of treaty violations for a good reason: to stop chemical attacks that were killing hundreds of innocent people. "I think that has been accomplished," Kucewicz says. "That to my mind is more valuable than getting some ironclad laboratory case."

In promoting his cause, Kucewicz has visited Meselson at Harvard and called him a number of times. His latest call came last September shortly after publication of a *Sci-*

entific American article that laid out the evidence for the bee-feces theory. Meselson had written the piece jointly with Seeley; Nowicke; Pongthep Akkratanakul, an entomologist at Kasetsart University in Thailand; and Jean Guillemin, a Boston College sociologist.

Meselson spoke to Kucewicz at some length, and a few days later, an editorial in the *Wall Street Journal* said that the "Meselson group had failed in its effort to find yellow-rain toxins in bee droppings." The group had also "failed to report these negative findings in its *Scientific American* article." As a result, the editorial said, "the notion that the toxins were natural products has collapsed." The editorial neglected to mention that neither Meselson nor the other researchers believed that toxins were naturally found in bee feces. Their point was precisely that yellow rain is a harmless natural product. Meselson says he repeatedly told Kucewicz that his group could not explain how Chester Mirocha's lab had found toxins in six yellow-rain samples.

Some scientists now question the validity of Mirocha's findings. Another group of scientists recently reported that a certain type of fungi found naturally in Southeast Asia does produce trichothecene toxins when cultured in a lab. The question of whether there actually were toxins in those six samples and if so, where they came from, remains unresolved.

*The real tragedy of the
yellow-rain affair may be the administration's
inability to accept informed criticism.*

Preserving the Future

To many observers, the real tragedy of the yellow-rain episode is the administration's inability to accept informed criticism. "There's no place for academics in Washington right now, and I think that's a real problem," says Jean Guillemin. "In particular, it's unfortunate that someone who is as intelligent as Matt and who has such good experience in terms of science advising should be relegated to the outside." Meselson also knows a great deal about military strategy: he has often advised Pentagon officials on the battlefield use of chemical and biological weapons, and he teaches the only course on conventional warfare offered at Harvard.

During the yellow-rain dispute, Meselson has found himself in the uncomfortable position of having to choose between being "patriotic" and publicly criticizing what he considers a dangerous policy. "Matt is actually very patriotic," Guillemin says. "I think he felt rather sad about the whole thing."

Meselson himself will not acknowledge that the yellow-rain affair has had any emotional effect on him. In fact, when I asked him how he felt about being shunted aside as a government consultant after 20 years, Meselson seemed insulted. Peering impatiently over his bifocals at me, he said, "You're asking me questions I don't think about much. Yellow rain is a very small part of my life. If you could crawl inside my brain, you would see that it's down there with the noise."

Yet according to those who work with him, the Harvard geneticist has been obsessed with proving that yellow rain is not chemical warfare. His graduate students say that he has been relatively inaccessible, and that indeed the yellow-rain affair has taken a heavy toll on both him and his lab.

"He's not around much," says Bob Cohen, a post-doctoral fellow who has worked in Meselson's lab for three years. "His lab is one of the best in the country, but it's not the best and that's why."

Meselson, for example, does not have time to attend many genetics conferences and spread the word about his students' work. The result is that when it comes time for his students to find faculty positions of their own, their names are not at the top of list.

"The way you get jobs is to publish," says one student. "But unless your results are really interesting, Matt doesn't want to write them up. He doesn't

care how elegant the experiment is."

Cohen, for one, was aware of Meselson's political interests and less-than-active involvement in the lab before he accepted a research position there. He says he decided to come anyway because he liked the type of research Meselson was doing. "He truly is a person of integrity, and it's hard to get mad at him," Cohen says. "For instance, when he says he's not interested in an experiment you've done, he does it in such a charming manner you're not insulted until after you leave his office and think about it awhile."

Cohen also says that although Meselson is very civil to everyone in his lab, he simply doesn't want to know about their problems, personal or scientific. The day Meselson received his MacArthur grant, the entire lab sat around drinking champagne and shooting the breeze. As Cohen tells it, a graduate student who is no longer with the lab got a little drunk and started yelling at Meselson: "You're not interested in the lab, you're only interested in chemical warfare. You're an asshole."

Meselson didn't even blink an eye. "He just sat there and explained that science is always up there waiting to be discovered, and if something is discovered a month later, so what?" Cohen recounts. "But politics, he said, is not like that. You have to act on political problems with some urgency; you can't wait around for the other shoe to drop. I have to say it was a good answer."

There are, however, two people for whom Meselson has an infinite amount of time: his daughters, Zoie, 15, and Amy, 13. One day, Baldwin recalls, Zoie and Amy were devising a treasure hunt around Harvard Square for their school friends, and they came into the lab to seek their father's help. "He walked the whole route with them—this was in the middle of a working day—and helped them come up with clever phrases for the clues. He was very patient with them," says Baldwin. "When his daughters come to visit, he doesn't care about the 10 phone calls he has to return."

Baldwin notes that Meselson is a different person around his pretty, dark-haired daughters—happy and less constrained. "He laughs a lot when they're around. I think his daughters mean everything in the world to him."

Perhaps, as one colleague suggests, his daughters represent the future for Meselson—a future he is trying very hard to preserve. □

Following seven years of deliveries that were on time or ahead of schedule, Hughes Aircraft Company has completed production of the electronic "brains" for the U.S. Navy's Trident I Fleet Ballistic Missile. The guidance electronic assemblies incorporate advanced technology to withstand harsh operating conditions underwater and in space. Since 1978, Trident guidance assemblies containing Hughes electronics have performed flawlessly in 50 test launches. This reliability record follows outstanding performances established by Hughes in the past 25 years on the Polaris and Poseidon programs. Fabrication of development guidance electronics flight hardware has begun for the Trident II missile.

The U.S. Department of Defense has given two of its four top money-saving awards to Hughes for proposals that will cut costs by nearly \$275 million. The Contractor Value Engineering Achievement Awards honor defense contractors for helping to trim defense costs during 1984. The Air Force cited Hughes for saving \$172.8 million on the Imaging Infrared Maverick air-to-surface missile over the life of the contract. The Navy honored the company for reducing projected costs on the UYQ-21 data display system by \$101.5 million. Hughes also contributed to the savings achieved by FMC Corporation, which won the Army award for cost-cutting efforts on the Bradley Fighting Vehicle System. The Value Engineering program was created to cut production costs without affecting performance, reliability, quality, maintainability, and safety standards. The armed forces approved 34 Hughes VE proposals for total cost reductions exceeding \$296 million. Since 1964, Hughes military customers have approved 705 changes on 52 programs for total savings of \$887 million.

Telecommunications via satellite continue to bring Indonesians closer together by bridging the thousands of islands of their nation. In 1976, Indonesia became the first nation after Canada and the United States to operate a domestic geosynchronous communications satellite system. Long-distance telephone traffic more than tripled in the first five years and continues to grow. New Palapa-B satellites have improved the quality and efficiency of services while expanding coverage into Papua New Guinea and into smaller communities and outlying areas of Indonesia. The increased power of the Hughes satellites allows ground stations to use antennas 3 to 4.5 meters in diameter, as opposed to the 10-meter antennas at all the original stations.

Advanced computers give North America's new air defense system more capability at a fraction of previous operating costs. The Joint Surveillance System (JSS), developed for the U.S. Air Force by Hughes, watches over the entire United States and Canada from eight regional operations control centers. The system is controlled by nine Hughes 5118 ME central computers, each with 500,000 words of memory and capable of performing 1 million operations per second. These computers, in turn, direct seven Hughes HMP 1116 peripheral computers to perform subordinate tasks. The system provides its own back-up whenever faults are detected. Because the system requires less staff and maintenance than the previous system, JSS saves over \$100 million a year in operating costs.

Hughes' Santa Barbara Research Center is seeking experienced engineers and scientists to further develop advanced IR systems. We need design engineers, nuclear effects engineers, electro-optical packaging engineers, IR system analysts, and project leaders. To learn how you can become involved in the development of new IR systems, contact the Santa Barbara Research Center, Professional Employment, Dept. S2, 75 Coromar Drive, Goleta, CA 93117. Equal opportunity employer. U.S. citizenship required for most positions.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068



*Developed nations
must disclose the hazards of their exports, but
poor nations also have to rethink their
development goals.*

The Dilemmas of Advanced Technology for the Third World

IN 1972, the Consumer Products Safety Commission mandated that children's sleepwear be treated with a flame retardant such as Tris, or 2,3-dibromopropylphosphate. However, in 1977, after studies showed that Tris is a mutagen in bacteria and a carcinogen in animals, the commission banned the sale of Tris-treated pajamas in the United States. Distributors, stuck with millions of dollars' worth of Tris-treated garments, began marketing them abroad. Even though an enormous public furor ensued, the commission ruled that it had no authority to ban the sale of products to other countries. As public pressure mounted, the commission reversed its decision and banned the export of Tris-treated clothing. Still, over 2.4 million pairs of pajamas had already been exported.

Also during the 1970s, the Velsicol Chemical Co. sold 14 million pounds of an insecticide called Phosvel, manufactured near Houston, to Egypt, Indonesia, and South Vietnam, where it was used on cotton and other crops. The company was in the process of testing Phosphel but

had not yet received approval for domestic use. The exact toll of environmental and health damage is not known, but in Egypt alone the pesticide was implicated in the poisoning of 65 field workers, one of whom died, and the death of several hundred water buffaloes. The U.S. Occupational Safety and Health Administration later banned production of the chemical when a large number of workers at the Velsicol plant showed evidence of neurological disorders and the plant was found to have polluted the area.

These events focused public and congressional attention on an unintended result of tightening environmental and worker-safety regulations in the United States: the laws left the door open for manufacturers to export products that had been banned or not yet approved for domestic use. People were concerned that developing countries, which usually lacked the regulations and administrative apparatus to protect themselves, were being used as a dumping ground for products unwanted by the rich nations.

BY RASHID A. SHAIKH

Poor countries have viewed the need to increase food production and prevent malaria as more important than avoiding DDT's harmful effects.

The developing nations have recently been the site of several major industrial accidents—including the explosion of a liquified natural gas tank in Mexico that killed some 500 people, and the leak of deadly methyl isocyanate from a Union Carbide pesticide plant in Bhopal, India, that killed more than 2,500 people. These accidents have aroused concern about the export of hazardous industrial processes to developing countries, which often lack the infrastructure, including a reliable supply of electricity and skilled labor, to run such facilities safely.

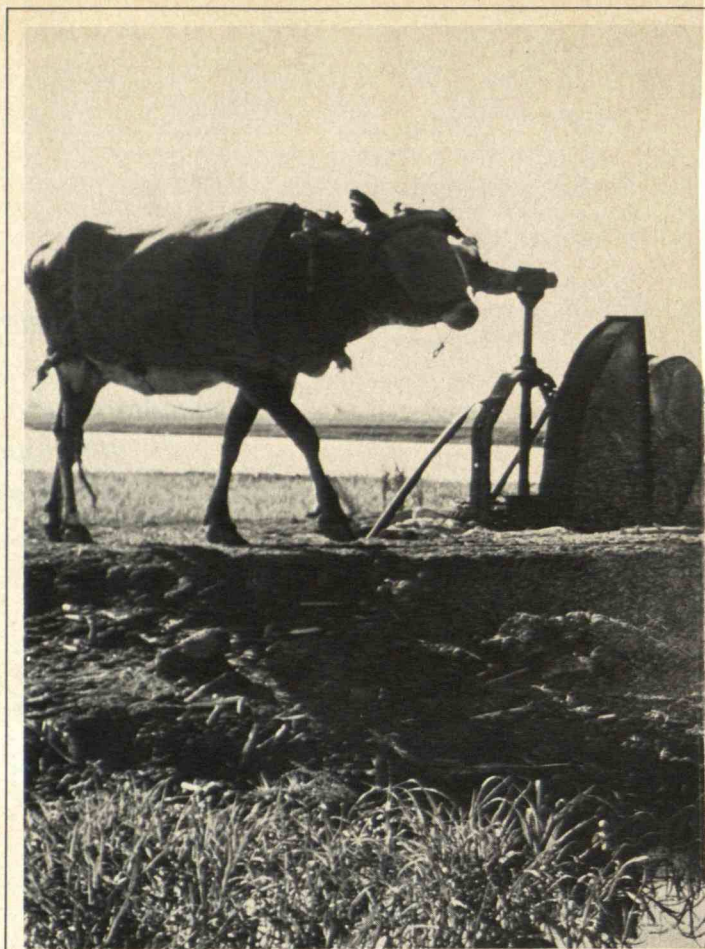
Today an international consensus is beginning to emerge on the issue of controlling the export of hazardous products: developed nations are recognizing that they hold some responsibility for informing importing nations about the health effects of these products. However, a framework for dealing with the complex problems posed by the export of advanced industrial processes has yet to emerge. The issue is complicated because there are no internationally accepted standards for industrial operations, developing countries have generally not given high priority to worker health and environmental issues, and factories in the Third World are often only partly owned by multinationals based in the developed countries. International organizations could do more to encourage developed nations to disclose the hazards of industrial processes. But problems will continue to occur until rich and poor nations alike rethink their pursuit of development in the Third World at the expense of all other concerns.

The Complexities of Hazardous Exports

The General Accounting Office has found that about one-third of the pesticides that the United States exports cannot be sold domestically because of health and safety regulations. Many other consumer products, chemicals, and pharmaceuticals banned or severely restricted in the United States have also been exported, including toys that do not meet U.S. standards and drugs that are mislabeled.

Why don't the United States and other industrial countries pass laws making it illegal to export all

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products that they have not approved for domestic use? Such bills have been introduced in the U.S. Congress on more than one occasion. These bills seek to use the authority of the Export Administration Act—which allows the president to restrict exports to achieve foreign policy goals—on the basis that the sale of hazardous products abroad affects U.S. prestige. However, the issue is not a simple one. In some cases developing countries want to use products that industrialized nations consider hazardous. In other cases, products that are safely used in industrialized nations prove dangerous in developing countries.

Depo-Provera, an injectable contraceptive, is one example. The drug remains effective for three to six months, depending on the dose. Despite a protracted battle by Upjohn, the manufacturer, the U.S. Food and Drug Administration (FDA) has not approved Depo-Provera for contraceptive use because it has been shown to cause cancer in laboratory dogs and monkeys. Yet some 80 other countries have approved the drug for contraceptive use, including industrialized nations such as West Germany, Italy, and Canada and developing nations such as Nigeria, Kenya, Malaysia, Thailand, Colombia, and Mexico. Many developing countries think that the benefits of using Depo-Provera outweigh its risks: the drug works and is much more convenient than other



birth-control methods such as the pill and the condom, which require regular use. These nations have decided that, given their high rates of population growth and maternal mortality during childbirth, using Depo-Provera for birth control makes sense.

However, the United States cannot use Depo-Provera in the family-planning programs it funds in other countries because the Food, Drug, and Cosmetic Act does not allow the foreign sale of "unapproved new drugs." Organizations such as the International Planned Parenthood Federation, as well as health officials from developing countries, have requested that the United States make an exception in this case, but the law prohibits such exceptions.

Some developing countries have also continued to use the insecticide DDT, which is effective against a wide range of pests, even though most uses have long been banned in the industrialized nations. Poor countries have viewed the need to increase food production and prevent malaria and other insect-borne diseases as more important than avoiding DDT's possible long-term effects on human health and its adverse effects on the reproduction of birds. DDT use in developing nations is now declining only because pests have become resistant to it.

The Federal Insecticides, Fungicides, and Roden-

ticides Act allows the export of banned pesticides, so U.S. firms can sell DDT to other countries, and until 1975 it could be used in U.S.-sponsored pest-control programs. This policy changed after public-interest groups, including the Natural Resources Defense Council and the Environmental Defense Fund, sued the government. In an out-of-court settlement, the government agreed to stop using banned and unapproved pesticides in the programs it sponsors.

Infant formula, a breast milk substitute, is a product that has long been used safely in the industrialized countries but that causes problems in developing nations. Heavy promotion of infant formula in many Third World countries, including Sri Lanka, Zimbabwe, and Malaysia, has resulted in serious injury to many infants. Clean water for mixing the formula is often unavailable and mothers frequently dilute the milk substitute to make it last longer. In the 1960s, companies began paying women dressed as nurses to give mothers free samples. After much controversy and a consumer boycott of Nestlé, a major producer of infant formula, the World Health Organization drew up a voluntary code for companies to follow in advertising and marketing the product. Most companies, including Nestlé, appear to be abiding by the code.

The Notification System

Questionable export practices led to a debate in the late 1970s over what U.S. policy should be regarding the sale of hazardous products abroad. Allowing U.S. companies to freely export products that were restricted or banned from domestic use would be an obvious case of double standards—a position that many in the Carter administration and Congress found morally repugnant. International attention was also focusing on the export issue, and the U.N. General Assembly passed a resolution in 1979 urging member countries to exchange information on hazardous chemicals and pharmaceuticals. Inaction by the United States would clearly have brought this country into disrepute. On the other hand, the United States was afraid it would be accused of paternalism and imposing its standards on other countries if it banned specific products.

Congress responded to these concerns by incorporating a "notification" system into the seven laws governing the manufacture and sale of pesticides, chemicals, and consumer products. Under this sys-

Even though U.S. law prohibits the export of unapproved new drugs such as Depo-Provera, many poor nations want to buy the injectable contraceptive because of their high maternal mortality rates.



tem, the EPA, the Consumer Products Safety Commission, and the FDA, usually working through the State Department, inform importing countries of the regulatory status of the products being exported to them. The U.S. government also expresses a willingness to give importing countries more information on the health effects of these products. This policy is intended to allow other countries to make informed decisions on whether to import the products and to avoid imposing restrictions that would hurt U.S. industry.

Yet because this notification policy was incorporated piecemeal into several statutes, U.S. export policy remains fragmented and inconsistent. For example, while new unapproved drugs cannot be exported, approved drugs whose strength and purity has been changed, drugs whose shelf-life has expired, and drugs with labels that make false or misleading claims can be sold abroad without notification. In

its final days, the Carter administration issued an executive order aimed at coordinating U.S. efforts to control hazardous exports. The administration planned to draw up an annual list of all products banned or restricted in the United States, and to prohibit extremely hazardous products from export without a specific license. The government also planned to encourage international efforts to control hazardous exports. However, industry strongly opposed this policy, and President Reagan revoked the order a few days after taking office.

The current administration is required by law to continue to send notification on hazardous products to importing countries. But the United States has backed off from taking the lead role in encouraging international cooperation in this area. In fact, this country has consistently opposed efforts by the United Nations and the Organization of Economic Cooperation and Development (OECD), whose 22 members include the world's major industrial nations, to collect information and draw up guidelines on hazardous exports.

For example, the U.N. General Assembly has recently asked the secretary general to prepare and regularly update a list of chemicals "whose consumption and/or sale has been banned, withdrawn, severely restricted, or in the case of pharmaceuticals, not approved by Governments . . . the list should contain both generic chemicals and brand names . . . names of all manufacturers, and a short reference to the grounds and the decisions taken by Governments." The United States cast the sole negative vote against these recommendations. Nevertheless, the second edition of this list will be published this year.

The notification concept has also gained widespread support in the international community. The U.N. Environment Program (UNEP) has called on countries that export hazardous materials to provide information on their effects to importers. The UNEP proposes that a copy of all notifications be sent to the United Nations so that the products can be included in its list of hazardous substances. The OECD has also recommended that exporting countries notify importers of banned or severely restricted products. OECD members, especially the Netherlands, England, and West Germany, are beginning to develop export-control laws, but the U.S. is still the only country with a notification policy in place.

The notification system is a significant development because it recognizes that exporting govern-

Thousands had to flee their homes after the accident at Union Carbide's Bhopal plant, which was operated in blatant disregard of the standards the company had set for such operations.

ments share responsibility for protecting foreign citizens from exposure to hazardous products. Yet this system suffers from some major flaws, and in practice proves to be quite weak. For example, the technical information that is the basis for U.S. regulatory decisions is not included in the notification sent to importing countries. This means that these countries do not have any basis for making an informed decision on whether to buy the products. And few developing nations have requested more information on imports from U.S. agencies. Moreover, different U.S. agencies have different objectives, with the EPA and FDA more willing to provide information than the State and Commerce departments. At least under the current administration, these departments would rather promote free trade and reduce regulations.

The various agencies of the importing nations may also have competing objectives. A developing country's decision on whether to import a certain product may hinge on which agency receives notification. For instance, public-health officials may disagree with agriculture officials on whether to import a pesticide. These pitfalls make the U.N.'s list of hazardous products especially valuable since it gives citizens and government officials alike access to the information. Indeed, the U.N. list has elicited much attention from public-interest groups in developing nations. In the long run, this list, combined with notifications between exporting and importing countries, will enable developing countries to make better decisions about which products to import and how to use them.

Trade in Hazardous Industrial Processes

Some environmentalists have feared that just as restricting the domestic sale of unsafe products has led U.S. companies to export them, stringent environmental standards would prompt U.S. firms to move their manufacturing operations to countries with more lenient regulations. Developing countries would thus become "pollution havens" where manufacturers could avoid the cost of meeting U.S. standards while continuing to make products for use in industrialized countries.

Jeffrey Leonard of the Conservation Foundation has found that these fears are largely unfounded: no large-scale movement of U.S. industry abroad has occurred because of stricter environmental regula-



tions. These regulations do affect companies' decisions on where to site their plants, but they do not outweigh factors such as import and export tariffs and the cost of transporting goods. Even the industries most strongly affected by environmental regulations, such as the mineral-processing and chemical industries, have not seen a large-scale exodus abroad because of these laws.

Still, Leonard has found that the United States has come to rely on overseas factories, often partially or completely owned by U.S. firms, to supply products in a few troubled industries. The prime example is the asbestos industry. The adverse health effects of asbestos are well known: exposure leads to the debilitating lung disease called asbestosis and the nearly always fatal cancer called mesothelioma. Federal restrictions have reduced direct consumer contact with asbestos fibers, and the EPA is planning to phase out most uses. However, no substitutes are yet available for automobile brakes, and asbestos has

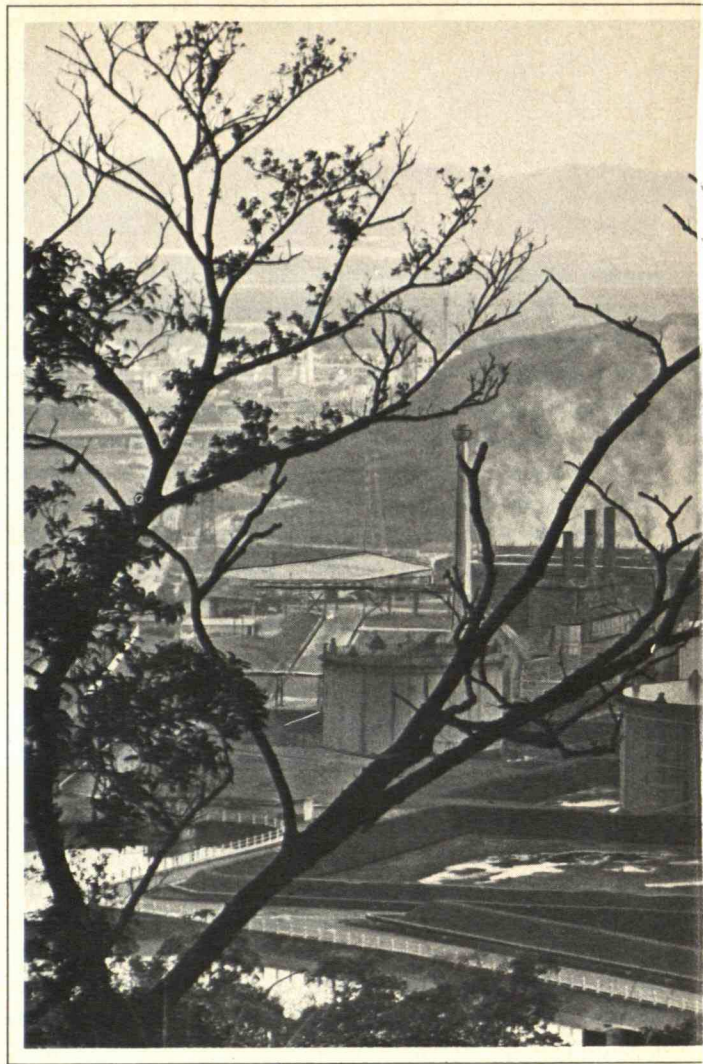
continued to be used in some industrial textiles. Thus, the U.S. market for the material has remained large. Limits on asbestos exposure of U.S. workers have shut down most domestic production; Mexico and Taiwan have replaced the United Kingdom and Canada as the world's major suppliers.

Unfortunately, conditions at asbestos plants in many developing countries, including those operated by affiliates of major British and American firms, are decades behind the standards of those at home. According to environmental consultant Barry Castleman, asbestos dust in a Bombay plant that is 74 percent owned by the British firm Turner and Newhall is like the dust "behind a bus on a dirt road in the dry season."

Environmental regulations in the industrialized nations have also led to a dramatic change in the world's production of arsenic, a cancer-causing substance that is used in making pesticides, glass, wood preservatives, and semiconductors. For example, in 1955 the United States imported 35 percent of the arsenic trioxide—the main source of arsenic—it consumed. By 1970 imports had jumped to 55 percent, and by 1984 all arsenic used in the United States was imported. Production has largely shifted to developing countries, particularly Peru, Mexico, and the Philippines. Some of the plants in these countries are partially owned by Asarco, the last U.S. producer, which shut down its remaining domestic plant after pressure from the EPA to reduce sulfur dioxide and arsenic emissions.

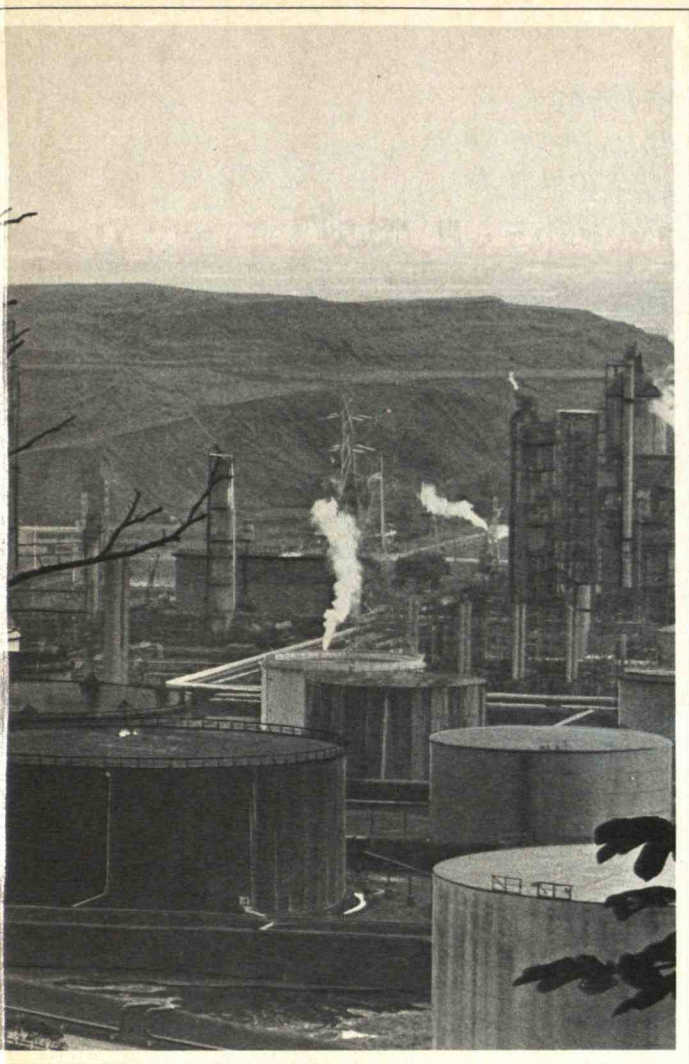
Even industries that have not moved most of their operations to developing countries maintain different health and safety standards in various countries. According to a study by the U.N. Center on Transnational Corporations, most parent companies maintain no worldwide corporate standards and exert only loose control over their subsidiaries in developing countries. These subsidiaries accommodate their practices to local standards, which are often weak and not enforced.

For example, Union Carbide's pesticide plant in Bhopal, which is 51 percent owned by the parent company, operated in blatant disregard of the health and safety standards that the parent company had developed for such operations. Conditions at the plant were so bad that according to Warren Anderson, chairman of the corporation, it "should not have been operating." All the details on the accident are not yet known, but water probably entered the



tank containing methyl isocyanate because of faulty valves and inappropriate alterations in the plant design. This started a runaway reaction. Safety systems that would have minimized the effects of the reaction, and possibly prevented it, were not functioning. The refrigeration unit, intended to keep methyl isocyanate cold and thus prevent it from evaporating, had been shut off. The scrubber, designed to neutralize any escaping gas, needed repairs and was out of operation, as was the flare tower designed to burn off any escaping gas. Temperature and pressure gauges intended to warn workers that trouble was occurring had been disconnected. Union Carbide in the United States knew that maintenance and safety standards in the plant were extremely lax but failed to force management to improve the situation.

The conditions in the Bhopal plant were in marked contrast to those at Carbide's sister pesticide plant in Institute, W. Va. After the Bhopal disaster, Union Carbide upgraded the safety system at the Institute plant and assured nearby residents that an accident like the one in Bhopal could not occur in their town. A leak of aldicarb oxime on August 11, 1985, proved the company wrong. However, no one died



in the incident, and the management at the Institute plant would clearly never have tolerated the numerous operating violations that occurred in the Bhopal plant.

Governments in developing nations must share responsibility for upholding environmental and safety standards, and they must give these issues higher priority. The plant in Bhopal operated in an area where efforts to protect public health and the environment receive low priority. The state of Madhya Pradesh had too few factory inspectors who had too little power. What made the tragedy so significant was the plant's location: it was near the center of a city of 700,000 people and surrounded by shantytowns. The Madhya Pradesh government had enacted legislation requiring hazardous industries to move away from population centers, but the law excluded pesticide manufacturers. Newspapers quoted the state's chief minister as saying, "The Union Carbide plant is not a toy to be played with."

Yet the legal responsibility for protecting the health of workers and the community rests with the company, not the local government. The legal issue is complicated by the fact that local subsidiaries vary

The disastrous results of the single-minded rush to modernize are becoming clear.

in whether they are wholly owned, partially owned, or licensees of a parent company. Some factories and advanced technologies may also be partially or completely state owned. There have not been very many lawsuits to decide who is liable in these different cases. In the absence of legal precedents, international organizations can play a very important role in devising guidelines on industrial health and safety. The World Bank has recently developed a system that companies use to evaluate the hazards of plants funded by the bank. The companies then incorporate safety systems into the plants to deal with the hazards (see "World Bank Acts to Prevent Chemical Disasters," page 65). These procedures are based largely on guidelines developed by the European Economic Community after the explosion at a chemical plant in Seveso, Italy, in 1976.

The United Nations and the OECD should also develop guidelines for multinational companies planning and running factories in developing countries. Furthermore, the two international organizations should collect and disseminate information on hazardous manufacturing processes. These efforts would not carry legal weight. However, as in the case of the WHO infant-formula code, they would provide a framework that governments and companies could use to examine factory operations in developing nations.

Pressures to Modernize

Many of the problems in controlling the use of dangerous industrial processes, as well as the sale of hazardous materials, stem from the dogma of development that planners worldwide have adhered to during the past 30 years. Both rich and poor nations, as well as the international lending institutions, emphasize industrialization in the Third World at the expense of other concerns, including a more equal distribution of income, adequate housing, improved nutrition, and wise management of resources. Developing countries see industrialization as a way to solve many of these problems, but in fact it often exacerbates them. The Indian government considered Union Carbide's Bhopal plant part of a scheme to modernize the country, save foreign currency by making products locally, and become self-sufficient in food production. India now does produce all its own food, but the disastrous results of such a single-minded rush to modernize are becoming clear.

The severe cases of urban air pollution stemming

It is crucial for poor nations and their sponsors in rich nations to examine all the benefits and costs of advanced technologies.



from rapid industrialization in developing countries are one result. In Brazil's city of Cubato, near Sao Paulo, the pollution from a petrochemical center is so high that the city is called the "Valley of Death." Cubato reports more cases of cancer, stillbirths, and birth defects than any other area of Brazil. The pollution has killed much of the vegetation on mountains behind the town, and landslides have become frequent. Yet the Brazilian government often cites Cubato as a successful case of industrialization.

Agriculture provides another example of the problems that result when poor countries try to apply the technology of industrialized nations too zealously. Modern agriculture relies heavily on the use of pesticides. Yet in the developing countries the cost of good-quality spraying equipment and protective gear are prohibitive, information on the hazards of pesticides is scarce, and monitoring of workers for adverse health effects is rare. Even mechanization can damage human health. For example, mechanized cotton pickers harvest more of the "trash" component—the seeds and other material not part of the cotton fiber. This trash is thought to cause brown lung, the disease that debilitates textile workers. Textile machinery can be retrofitted with dust controls to help prevent this disease, but the technology is expensive, as is an adequate ventilation system. Poor

countries often fail to take into account the costs of such health and safety controls when deciding whether to adopt advanced technologies.

The introduction of modern technologies and products into developing countries is not inherently good or bad. However, it is crucial for planners in the poor nations, as well as their sponsors in the rich nations, to examine the full range of benefits and costs that such technologies entail. For example, developing countries must devise a pest-control policy before deciding which pesticides to import or manufacture. To do this, planners must decide which pests are the most important to control, whether chemical pesticides are the best agents for doing so, and what alternative strategies are available. Perhaps better methods of cultivation and biological controls could substitute for intensive use of pesticides.

Industrial development is not a magic bullet that will erase the problems of the poor nations. Countries and international lending agencies must define their development goals, explore different strategies, and examine the full range of impacts before deciding which strategy to adopt. Only then will planners have learned the crucial lesson of Bhopal and other such disasters: that it is not possible to industrialize today and worry about public health and the environment tomorrow.

World Bank Plan to Prevent Chemical Disasters

BY ROGER BATSTONE, WITH WIL LEPKOWSKI

After the disaster in Bhopal, India, in December 1984, the World Bank recognized the need to develop a radical new approach to identifying, preventing, and mitigating major industrial accidents in developing countries. As a funder for industrial projects throughout the developing world, the World Bank has a great interest in protecting its investments as well as the people and the environment near the plants.

It is a well-proven fact that pollution prevention pays even in the absence of government regulations. Preventing major industrial accidents also pays. This realization led the World Bank to draw up guidelines to reduce the hazards of the projects it funds. These guidelines are leading engineers to develop less dangerous processes and to reduce their inventories of hazardous materials.

The bank's guidelines accomplish three things. First, they ensure that the people in control of operations that involve explosive, flammable, and acutely toxic substances identify in fine detail the dangers of the major accidents that could result. Second, the guidelines ensure that plant personnel will take every possible measure to prevent those accidents from occurring. Third, when accidents do occur, the guidelines give plant operators and local authorities the information they need to minimize the results.

The origins of the guidelines date back to the 1970s. Following the lead of chemical companies in Europe in the wake of major industrial disasters in Flixborough, England, and Seveso, Italy, the European Economic Community developed the Seveso Directive in 1982, which recommended a legis-



An Indian child plays on a pile of asbestos dumped by an affiliate of Johns-Manville Corp. The World Bank has denied loans to environmentally unsound, out-

dated plants in developing nations. Its new guidelines will require chemical plant operators to take action to prevent accidents and pollution.

lative approach communities could take to prevent future accidents. The World Bank issued preliminary guidelines based on this directive that applied to industrial processes and to the storage and transport of hazardous materials.

Experience with 20 projects in the first half of 1985 showed the need for a manual to guide plant designers in assessing the dangers of their factories. The manual was published in October 1985 and is being distributed worldwide. The bank hired two prominent British safety firms—Technica Ltd., and Cremer & Warner, Ltd.—to help them develop the guidelines and produce the manual, and to develop a computer program to guide engineers through the manual's steps.

The bank decided not to rely solely on assessment techniques used in the U.S. nuclear industry and the European chemical industry. In those industries, plant operators attempt to determine the probability that systems in their plant will fail, and then try to meet the criteria for acceptable risk set by government and individual companies. But these techniques ignore too many unknown factors: major accidents occur much more frequently than the analyses indicate. The techniques may also foster a dangerous sense of complacency that further increases the risk. It is much better to start with the attitude that if something can go wrong it will go wrong.

Engineers using the guidelines start by identifying a

possible failure. This could be anything from the rupture of a pipeline to the uncontrolled release of a toxic chemical through an emergency vent. The computer program leads analysts through calculations to estimate the toxic effects at varying distances from the release. The program also shows how the cloud of toxic gas disperses downwind and estimates the radiation effects, extent of flash fires, and explosion damage under varying weather conditions. Engineers repeat these calculations for the full range of failure cases. All the information is plotted on a detailed map of the plant and the surrounding area, with danger areas such as schools and homes highlighted.

The manual suggests a number of corrective measures. For example, in "knock-on" events in which a smaller accident triggers a major one—such as when a small fire causes a vessel storing a toxic material to leak, producing a toxic vapor cloud—the manual would suggest fire and blast wall protection, remotely operated shut-off devices, changes in equipment layout, and process changes.

The guidelines also aim to minimize the results of accidents by reducing the amount of hazardous material at a plant, or by making it the intermediate product of a new or modified process. One such project the bank has funded involves a key improvement on the process Union Carbide was using to make pesticides in Bhopal. In the new procedure, methyl isocyanate (MIC) is continuously manufactured and used for further reactions instead of being stored. The maximum amount of MIC in process at any time is four kilograms—a quantity that would have minimal impact

Chemicals from an Indian Dyestuff Industries plant flow into a nearby river. The World Bank guidelines help operators prevent the release of toxic substances.

outside the plant. Operators can stop the formation of MIC immediately by shutting off the heat supply to the MIC reaction.

The World Bank guidelines also require companies handling hazardous chemicals to develop on- and off-site emergency plans, including escape routes and public-alert systems, in case an accident does occur. Companies are also encouraged to modify the siting of their plants and set aside safety zones around hazardous installations to buffer the impact of an accident. The events at Bhopal and in many other accidents throughout the world have led to calls for educating communities as to what chemicals and processes are being used in their midst. The bank requires companies to coordinate their emergency plans with local authorities, who are encouraged to inform and involve the community.

However, the bank focuses on preventing hazards through changes in plant design rather than using emergency procedures to reduce the impact of an accident. The guidelines put special emphasis on the need to identify the potential for runaway reactions and the means of controlling them. (It is still essential for the major chemical companies to come together to address this problem more directly.)

Weighing the hazards of a plant at the design stage, or even of one that is already operating, is not that difficult. It does require the careful efforts of experts in chemical processing, engineering, construction, plant operation, and safety. The bank's safety and process experts review a company's assessments and may require plant owners to add more safety measures.



For example, the bank required one company producing and storing large amounts of refrigerated ammonia to redesign its expansion plans. The firm's managers had been operating under a false sense of security: it was their impression that the prevailing wind was almost always seaward, away from the surrounding community. While this was true during the day, calm inversion conditions prevailed at night. This meant that toxic gas would spread toward nearby housing, and that the plant presented a much higher risk to the community than the company had anticipated. The bank required the firm to add high walls around the storage vessels and to take other safety measures to reduce the results of an ammonia spill.

The safe operation of a plant depends on training, supervision, and other human factors that vary from company to company and country to country. Since the bank has limited enforcement powers once a loan has been disbursed and a plant built, safety becomes the responsibility of host governments, which often suffer from shortages of adequately paid and trained safety engineers. In an emergency, plant operators, managers, and relief

personnel often make erroneous decisions because they don't know what's going wrong. These decisions often make the release worse rather than containing it. The plant assessments can provide operators with valuable data in a simple format before an accident occurs, enabling them to make better decisions during an emergency.

Although the bank has not yet withheld funds because plants have failed to meet its criteria, it has done so in the past on related cases. In one such case, the bank recently refused to finance developers who wished to expand their capacity to produce chlorine using an outdated method. The company was using a process in which highly toxic mercury is an intermediary. A new process eliminates the use of mercury and reduces the risk of an explosion by separating the chlorine and hydrogen gases.

The costs of reducing hazards are not high. For new projects, the costs of doing the assessments and taking remedial action have been less than 1.5 percent of the total project costs. In some cases, the redesigned projects save money up front because they eliminate intermediate steps or reduce the amount of stored materials. The bank

also funds changes in existing plants, but it is usually much simpler and less costly to reduce major hazards before construction begins.

Some companies applying for World Bank loans are reluctant to comply with more stringent regulations in the Third World than in their home country. However, most borrowers welcome the bank's guidelines as necessary for protecting their investment, their employees, and nearby communities. In one instance, a borrower from Brazil came to the bank specifically because of its policy on major hazards. This company has adopted the bank's strategy for preventing accidents in all its operations.

There is no reason why any company operating anywhere in the world cannot use the bank's assessment techniques and simple but effective models to identify and reduce the risks of major accidents. Government engineers also can use these tools to monitor companies' compliance with regulations designed to prevent industrial accidents. □

ROBERT J. BATSTONE is the industrial pollution control engineer at the World Bank. WIL LEPKOWSKI is a senior editor of Chemical & Engineering News.

Bernard Bragg has won critical acclaim as an actor. He has never heard applause.

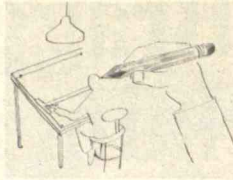


PHOTO ERNESTO BAZAN

Bernard Bragg is a co-founder of The National Theatre of the Deaf. He has performed on television and Broadway and was an artist-in-residence at the Moscow Theatre of Mimicry and Gesture. He has studied under Marcel Marceau and taught workshops at Harvard University.

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will take bootleg research and start spin-off companies, discourage such initiative. Research managers in the Japanese companies said that since such studies are crucial, they actually encourage them. Japanese companies don't need to worry because they are confident that engineers will stay with the company until retirement.

Only in the most formal sense is this activity unauthorized at Japanese firms, given the open physical layout of the research centers and the close interaction between engineers and supervisors. For example, Toshiba's development of the first Japanese-language word processor, which was initiated by a researcher at the central lab, took eight years. The project was unofficial for more than half that time. Two of the three Japanese companies even build about 10 percent "slack" into their budgets to cover such research.

Both the U.S. and Japanese companies monitor how well and how fast projects move from innovation toward production, yet they do so in different ways. Two of the Japanese firms review projects at their central labs annually and the third conducts semi-annual reviews. This contrasts markedly with the U.S. firms. Two of them establish timetables with clearly defined benchmarks, and the third company is considering instituting this system.

Despite the apparent looseness in Japanese firms, however, engineers feel much more pressure to deliver results than their U.S. counterparts. The Japanese research managers we interviewed stressed that engineers are motivated by their awareness of and commitment to the needs of the company. The Japanese engineers themselves feel that their employers rely less on employees' self-discipline and commitment than on externally imposed checks and controls. Research managers keep a daily eye on how well each project progresses. Moreover, scheduling becomes very aggressive once the project moves to the divisions, and there Japanese engineers feel severe time pressures.

Overall, then, Japanese companies set—and communicate—clear strategic and project goals. The strong contact between people in manufacturing and those in R&D serves to reinforce these goals. Indeed, manufacturing employees are an important reference group for Japanese engineers, particularly at the central labs. Japanese engineers there look most often for approval to the research administrator of their

group, followed by professional colleagues within their own group and then by manufacturing people. U.S. engineers, on the other hand, place a very low value on approval from production-oriented groups, looking instead to their group colleagues.

The Race to the Future

Japanese contributions to R&D in the computer industry are a strong inducement for U.S. firms to set up design facilities in Japan. However, American companies need to tie research with manufacturing operations in Japan to capture one of the key competitive advantages of the Japanese. Furthermore, a firm with stand-alone R&D facilities will not be able to offer an attractive career ladder to Japanese engineers, who expect to be able to move into line management positions. However, Japan is not a low-cost manufacturing site. Firms such as IBM, which established operations in Japan in the early 1950s, have a substantial advantage.

U.S. firms moving into Japan must also have long-term plans for cultivating relationships with the universities and with key professors. They must develop long-range strategies for planning the careers of engineers, for encouraging their Japanese researchers' participation in professional societies and meetings.

What do our findings suggest for U.S. firms in terms of "learning from Japan?" One key implication is that U.S. firms can do more to tie engineers' efforts to manufacturing. The Japanese maxim that "to move information you move people" is not one that is unfamiliar to U.S. firms, but it is one that they have found hard to practice. Inducing U.S. design engineers to follow one of their projects into manufacturing, on temporary assignment, might be one strategy. Assigning manufacturing employees to design teams is another possibility.

U.S. companies can also increase the amount of time engineers spend on design work, which they enjoy most and probably do best, by reducing their responsibilities for evaluation and supervision. Companies can also reduce the time engineers must spend attending meetings and writing reports that do not advance the research but simply constitute part of the monitoring process.

The slowdown of growth in the computer industry and the maturing of U.S. firms provide an opportunity for—indeed require—American firms to take

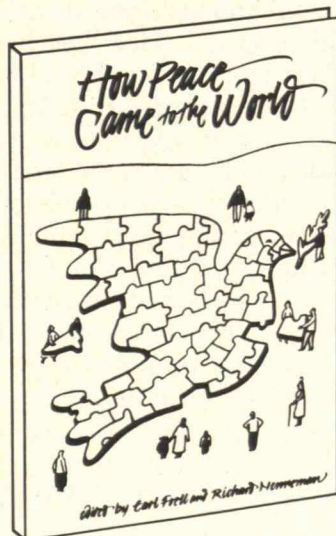
a more long-range approach to personnel planning. They should invest in employees as if they will be with the firm for many years, training engineers to their specific needs, taking longer to evaluate them, and rotating them among jobs.

The Japanese will also have difficulty learning from the U.S. experience. The fact that Japanese design engineers spend six to eight years in the central labs and then move on to design applications and line management may mean that companies gain on the handoff to production but lose on accumulated expertise and the capacity for innovation. However, if Japanese firms were to keep more engineers in design, they would sacrifice the standardization of careers that makes engineers accept and even welcome their transfers into production. Creating a second "elite" design track for a substantial number of

engineers might provoke serious resentments among those barred from such a track. And as the number of foreign subsidiaries and small entrepreneurial companies in Japan increases, more mid-career engineers might leave the large companies. The Japanese computer industry as a whole could benefit from such a development, but the large Japanese firms themselves are unlikely to welcome it.

This raises a final point of comparison. American computer companies have more flexibility in their structures and thus a greater capacity for experimenting with alternatives. This may well mean that American firms, and U.S. industry in general, will be better able to accommodate the changes necessary to compete worldwide—if they recognize and learn from the competitive advantages of their Japanese counterparts. □

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states, and virtually all of their benefits would be realized at the local or state level. There is, therefore, no case to be made for federal financing. In fact, there is a clear advantage to keeping the decision making in local and state hands: groups at these levels are best equipped to evaluate the needs that a high-speed rail system could satisfy.

The federal role appears best confined to advice, facilitation, and clearance. For example, the Federal Railroad Administration has, or has access to, more information on high-speed rail than any other public or private group. The FRA has the experience of carrying out the Northeast Corridor Project and has financed most of the preliminary studies of high-speed rail in the United States. The agency is ideally suited to provide advice to those involved in high-speed rail issues and can readily bring interested parties together.

As with other major construction projects requiring federal clearance, environmental impacts will be weighed at the state and federal levels, and the cost of meeting environmental regulatory standards will be included in the capital requirements for any high-speed rail project. The private owner-operator will also be responsible for meeting federal safety regulations. And finally, the economic development that results from the new rail system will be regulated at the local and state levels.

The major public participants in any new high-speed rail project will probably be the states within which the line is to operate. States might contribute toward construction costs, but indirect assistance is more likely—low-interest financing, free use of existing rights-of-way, aids to property acquisition, and tax abatements.

Local governments may finance and operate some parts of any new high-speed rail system. In New Jersey, the Atlantic County Improvement Authority will contribute funds toward a \$15 million Atlantic City terminal for the proposed Philadelphia-to-Atlantic City Amtrak extension. The American High-Speed Rail Corp. requested similar commitments from local governments in the Los Angeles-to-San Diego corridor.

High-speed rail will become viable only when the public sector and private investors find a way to value indirect benefits highly enough to make the sum of *all* benefits, public and private, direct and indirect, equal the costs, which will certainly exceed \$5 million per mile and may be more than twice

that. The returns from operating income alone are not likely to justify such a large cost to any private investor. Indeed, no high-speed rail project has been undertaken wholly by the private sector anywhere in the world. The Northeast Corridor Project, for example, was largely funded and managed by the FRA. Much of the construction was carried out by Amtrak. Significant financial contributions, in the form of cost-sharing agreements, came from state and local governments and private companies.

Finally, one problem will remain to be solved before appropriate financing can be obtained: some public agency must assure long-term continuity in the environment where any entrepreneur will build and operate a high-speed rail system. High-speed rail involves billions of dollars invested over hundreds of miles and affects millions of people. Such a system and its ancillary development will require upwards of a decade to build, and its investors may not receive adequate financial returns in less than a quarter of a century of operations. Many political jurisdictions will be involved throughout both periods, and the investors in the system must be protected from capricious changes in public attitudes and public-sector regulation.

Of all the states in which high-speed rail projects have been proposed, Florida is perhaps the farthest along in taking a truly creative approach to this problem. The Florida High-Speed Rail Commission has established close relations with other state agencies and with city and county agencies affected by the high-speed rail proposal. Hearings have been held throughout Florida, and by this summer the Commission expects to invite private-sector proposals for construction and operation of a system linking Miami, Orlando, and Tampa. Indeed, Florida will be this country's first good test of whether high-speed rail systems can acceptably balance tangible and intangible benefits and costs.

There are encouraging precedents, notably the original Tokyo-to-Osaka line in Japan and the TGV between Paris and Lyon: the economic result of both appears to be very positive. In addition, government-sponsored studies evaluating the U.S. Northeast Corridor and the high-speed train in Britain conclude that the overall benefits of high-speed rail should exceed the costs.

But the new proposals are difficult to judge because the tangible and intangible factors involved are so numerous. The juries are still out.

increase could enhance the greenhouse effect. However, meteorologists have found it difficult to quantify the sources of methane or figure out why its concentration is rising so fast.

Bacteria in such airless places as swamps, rice paddies, and the guts of cattle and termites produce most of Earth's methane. Hence, methane is not exactly a human-made pollutant. But its increase is linked with human activity. Cicerone says recent studies indicate that methane concentration has been rising for at least the past 150 to 200 years, paralleling the growth of human population.

The increase of rice paddies and cattle herds may be one factor. A population explosion of termite colonies on deforested land in the tropics also may have boosted global methane production. But in any event, meteorologists and biologists must work together to solve this problem. Assessing what the gas may be doing to climate requires an understanding of the total atmospheric methane cycle.

Creating a New Discipline

Cicerone says he does not underestimate the challenge scientists face in learning to work with an unfamiliar subject. One of the biggest challenges is to find meaningful ways to integrate knowledge of detailed ecological processes, such as the production of methane, into global mathematical models of the atmosphere. Computers programmed with these models are used to simulate climate.

While universities would not be wise to scrap their separate and specialized curricula in ecology and meteorology, integrating both sciences could and should produce a whole new scientific discipline in the next decade. As Paul Risser, an ecologist with the Illinois Natural History Survey, told experts at a recent American Meteorological Society meeting: "I think all of us believe we are at the forefront of a combination [of scientific skills] that will be enormously fruitful to science in general and, certainly, to the understanding of the biosphere."

Space probes show that Earth is the only life-sustaining planet in the solar system. Yet we are interfering with its ecology in a massive and ignorant way. We need the insight of an integrated earth science to develop a new program of planet maintenance that will ensure our long-term survival. □

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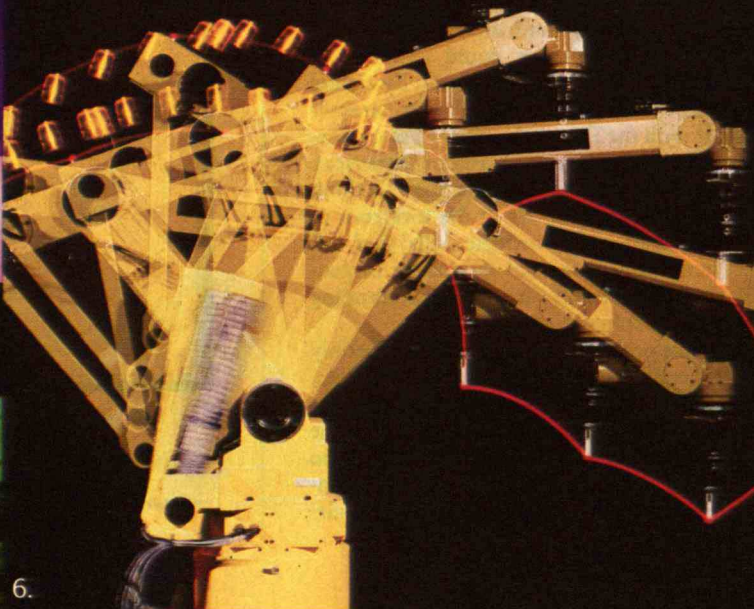


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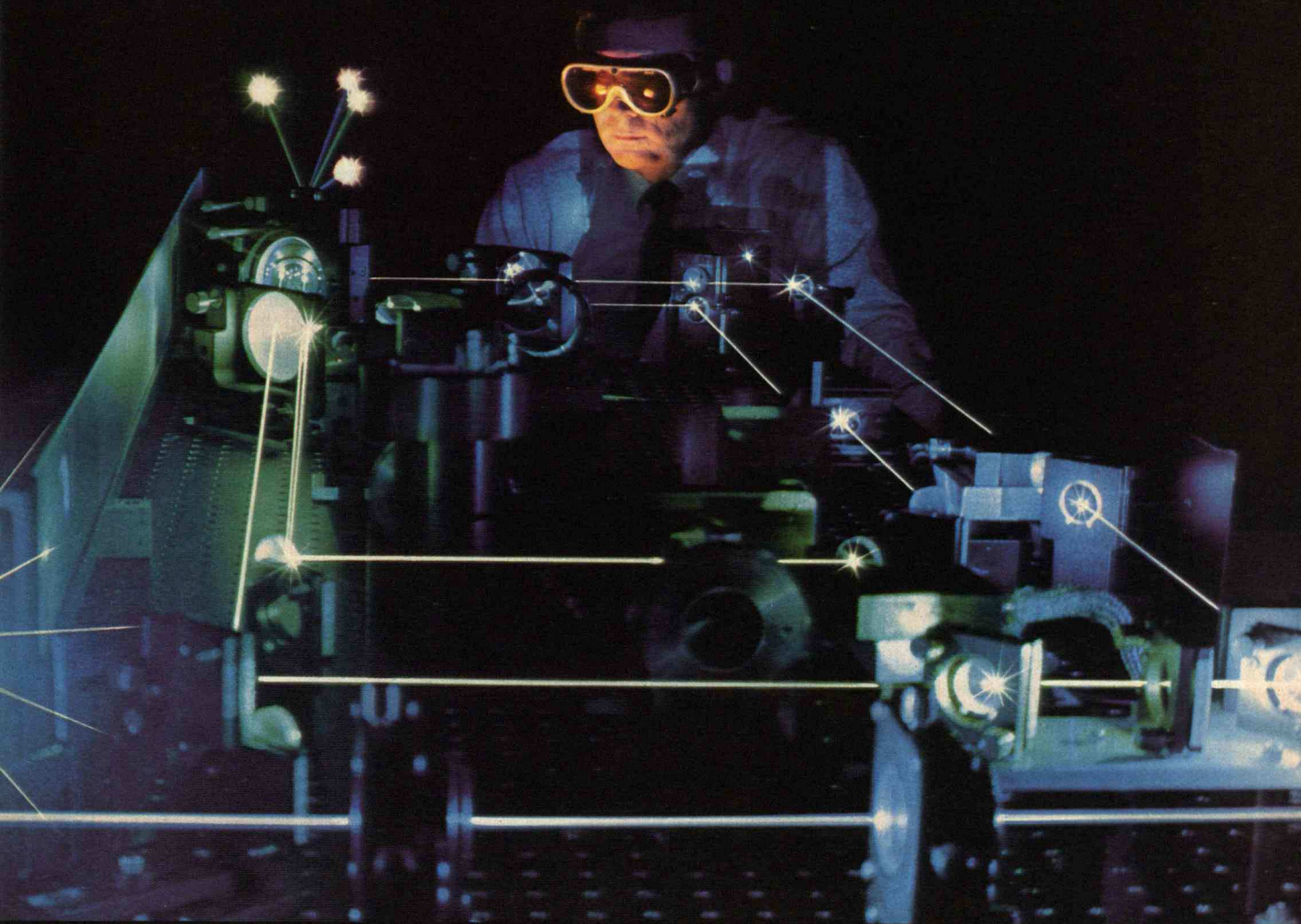


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The Space Age, Sustainable Agriculture, and Star Wars Scuffles

The Dawn of Space Flight

... *the Heavens and the Earth*
by Walter A. McDougall
Basic Books, \$25.95

Reviewed by Gerald Steinberg

OVER 300 million years ago, fish known as *Eusthenopteron* first left the shrinking rivers and mudflats and began to wander on the land nearby, gradually evolving into amphibians and eventually into other forms of life. A similar transformation may be taking place as *Homo sapiens* begins to leave the earth to establish itself in space during the second half of the twentieth century. Walter McDougall's ... *the Heavens and the Earth: A Political History of the Space Age* is a detailed chronicle of these first steps.

This carefully researched and highly literate volume is exceptional among the many histories of space flight. While technologically informed, McDougall has not succumbed to the temptation to worship the machines or the people involved. Instead, he has placed the enterprise of space flight in the perspective of other twentieth-century events. Although he emphasizes the political context, this book is not a diatribe against the evils of the activities of the military-technology complex in space. Rather, McDougall argues that a large-scale government-sponsored space program required the development and growth of "technocratic" methods and a technocratic ideology. From a political perspective, such technocracies are undesirable because they replace social and moral values with technical objectives.

McDougall's history begins during the first decades of this century when Konstantin Tsiolkovsky in Russia, Robert H. Goddard in the United States, and Herman Oberth in the Weimar Republic independently began to experiment with rockets and propulsion. All three were mavericks and to some degree misfits in scientific society. Tsiolkovsky was obsessed by dreams of spaceships driven by centrifugal force, Oberth's thesis on rocket propulsion was rejected by the faculty of Heidelberg, and Goddard's contemporaries "dismissed him as a crackpot."

Despite these rather inauspicious beginnings, rocket and space research accelerated quickly, according to McDougall, when governments in both Germany and the Soviet Union became actively inter-



ested in and assisted scientists' efforts. Under the Tsar, Tsiolkovsky had received little support for translating his theoretical calculations into the chemical rockets that he realized were the first necessary steps for escaping the earth's surface. However, the Bolsheviks did provide support and, more important, institutionalized this effort by establishing the Central Bureau for the Study of the Problems of Rockets. In Germany, the military took a major interest in rocketry, particularly since it could be camouflaged as a civilian activity and was therefore unrestricted by the Treaty of Versailles, which ended World War I. The relationship between the German military and rocket scientists grew until the rocketeers, led by Wernher von Braun, produced the V-2 rocket for the military in Nazi slave camps during World War II.

In the United States, government sponsorship of rocket and space research took much longer to develop. Here the tradition of keeping government small and relying on private enterprise to develop new technology persisted until the 1930s. According to McDougall, before World War II "the creation and application of new knowledge were properly left to private persons and institutions, plotting the nation's progress in a marketplace of ideas and techniques." In the spirit of free enterprise, this left business unfettered by government intervention. At the same time, Goddard and his followers had little to sell in such a pragmatic market.

However, the space program brought fundamental changes in the relationship between business and government in America, McDougall maintains. According to James Webb, NASA's first administrator, a successful space program required the United States to reexamine the relationship between "our two major organizational concepts through which the power of the Nation had been developed—the business corporation and the government agency." The process of cooperation between the two enterprises in developing major new technology actually began with the Manhattan Project. The process accelerated when the Atomic Energy Commission (AEC) was established and the Cold War intensified. However, the AEC had a very specific focus, and the Eisenhower administration still considered broader, larger scale government intervention in R&D undesirable. The president personally opposed extensive cooperation between scientists and the government, warning of the dangers of a powerful "military-industrial-technological complex." It took the shock of the launch of Sputnik on October 4, 1957, to force his administration into the drastic move of establishing a space technocracy.

The result was the creation of the National Aeronautics and Space Administration to oversee the development of civilian space technology and programs, and the creation of a parallel military space technocracy. NASA became a powerful bureaucratic organization with a multi-billion-dollar budget under President Kennedy, leading to the successful moon landing and the retrieval of U.S. prestige.

Perhaps because the institutions responsible for the military space program are more diffuse, or perhaps because satellites are less spectacular than the moon program, McDougall seems to have underestimated the scope and importance of unmanned military and civilian space activities. The importance of the Apollo moon landing seems largely symbolic from the perspective of 1986. In contrast, military and commercial satellites have had major and lasting worldwide effects.

Indeed, one might argue that the launch of *Discoverer 13*, the first U.S. reconnaissance satellite, in August 1960 marked the real opening of the space age. A few months earlier, a U.S. U-2 spy plane had been shot down over the Soviet Union trying to validate the Soviets' claim that they were producing hundreds of inter-

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continental ballistic missiles, while the United States had only a handful. *Discoverer* exposed Khrushchev's bluff and ended the Missile Gap. The successors to *Discoverer 13* have provided the United States with a constant stream of information on Soviet military activities, significantly reducing opportunities for deception and enhancing arms control.

In a similar manner, communications satellites have brought fundamental changes not only to the military but also to the entertainment industry and long-distance communications. However, McDougall largely neglects these systems and their implications.

There is also room to question McDougall's basic thesis that space flight required and enhanced the growth of a powerful state-controlled technocracy. Such institutional transformations undoubtedly stimulated the beginnings of space flight, but they may be incidental phenomena when seen from a broader perspective. Perhaps by the twentieth century humanity had simply evolved to the point where it could create the technology to leave the planet. Perhaps, like the *Eusthenopteron* 300 million years ago, humanity has merely been using its capabilities to respond to the challenges posed by its environment. □

GERALD STEINBERG teaches science, technology, and policy at Hebrew University in Jerusalem. The author of *Satellite Reconnaissance* (Praeger, 1983), he is a visiting scholar at the Institute for Global Conflict and Cooperation at the University of California at San Diego.

Toward a Sustainable Agriculture

Meeting the Expectations of the Land
Wes Jackson, Wendell Berry, and Bruce Colman, eds.

North Point Press, \$12.50

Reviewed by Stephen Budiansky

THE laissez-faire approach to managing natural resources, brought into favor with the coming of the Reagan administration, is based on a simple idea. Natural-resource problems—including overpopulation, desertification, deforestation, energy shortages, ozone depletion, carbon-dioxide buildup, soil ero-

sion, and endangered species—either do not exist or will be corrected automatically by the invisible hand of the marketplace. The argument is sometimes even heard that resource problems are not problems for the very reason that they reflect the will of the market. For example, economist Julian Simon of the University of Maryland has said that "wonderful though this Illinois land is for growing corn and soybeans, it has greater value to the economy as a shopping center . . . Under these conditions, no one would ever argue that the land should be required to remain in the production of corn and soybeans."

Because this approach has gained favor, it probably doesn't hurt for us to be reminded that this country does have genuine natural-resource problems, particularly in agriculture. In *Meeting the Expectations of the Land: Essays in Sustainable Agriculture*, edited by Wes Jackson, Wendell Berry, and Bruce Coleman, various authors describe the resource problems of U.S. agriculture and put forward a vision of an alternative system. There is no disputing their view that someday we will have to be more careful about how we use energy in farming: our current system of food production that requires 10 calories of fossil fuel for every 1 calorie of food energy delivered is not, in the language of these critics, sustainable. Though the market will surely take care of many such concerns when the time comes, some problems such as soil erosion may reach crisis proportions before the market corrects them, because their economic effects become obvious only over the long term.

Does that mean we should pursue all the goals of the sustainable-society school, such as local production of food, increased use of horses, and drastic cuts in the use of chemicals in farming? In the long run, the need to adopt some of these options may be unavoidable. But the real question is whether we are willing to make them matters of public policy today. Many of these ideas are very expensive to put into practice. A study in Iowa showed that the costs of maintaining an equilibrium between soil erosion and new soil formation exceed the short-term benefits by a factor of three. Who is going to pay to set up such a program? As recent events have shown, it is hard enough to obtain federal funds just to keep farmers in business, much less keep them in business conserving soil or growing wheat in New England.

The real question is whether we are willing to make the goals of the sustainable-society school public policy today.



I fear it is frustration with this reality that motivates the authors of *Meeting the Expectations of the Land*. Of course, by raising the practical issue of money I am revealing myself to be one of those that Wes Jackson dismisses as having a "narrowly analytical mind" that is satisfied with "mere economic considerations" and "unable to tolerate the ambiguities associated with the larger constellation of considerations that impinge on a problem." Jackson and his co-authors, who presumably suffer from no such failing, refuse to trouble themselves with petty issues such as federal farm policy and its "narrow" economic focus. They are out to reform our entire culture. How? Apparently by writing manifestos.

Gene Logsdon sets the tone, telling us that "in remaking an agriculture that is technically correct for sustainability, we must make sure it is also culturally correct or it will not succeed." He does not provide any clues as to how agriculture is to be "remade" or who is going to do it, though the book's other authors do offer ideas on what the new agriculture ought to be like, or at least what theories of culture it should be based on. In their view, "good farming" makes people healthier, promotes a more just society, and preserves "the earth and the network of life." "Bad farming" makes Twinkies. Draft horses are good because they "acknowledge the fact that farms, like ecosystems, have biological rhythms." Scientific reductionism—the efforts of scientists to

break down everything into smaller components—is bad. "When we look at the major problems of modern agriculture—soil loss, chemical dependence, increasing dependence on fossil fuel, loss of the family farm, more corporate farms, and expansion of agribusiness—we see that most of these are the consequence of too much reductionism." Well.

It would be hard to draft a piece of legislation to tackle the problem of "too much reductionism." Manifestos do have their place, of course, and in fairness we do not expect Thoreau to recommend legislation. But we do expect him to be pithy, or at least novel. To the extent that Jackson et al. can open our eyes to the possibility that farming—dare I say profitable farming—does not have to depend on tractors, fossil fuel, million-dollar debt loads, and acre after acre of corn planted fence-row to fence-row, one can forgive their disdain for the realities of effecting change in a democratic society.

Harder to forgive are the odd bits of anti-intellectualism that keep popping up, such as cracks about "the computer boys" and assertions, based on "the farmer down the road," that traditional varieties of open-pollinated corn yield just as much as hybrids. Also hard to accept is the solace the authors find in blaming the rise of modern farming not upon farmers who have made free choices, but upon a conspiracy of implement manufacturers, chemical companies, and extension agents who supposedly forced it on them. Whether the authors or any of us like it or not, most farmers prefer tractors to horses. They burn their straw instead of composting it with manure not because they have been brainwashed that it is the modern thing to do, but because it is cheaper to buy chemical fertilizers than to pay for labor to handle the straw.

That situation may well change someday, but not because advocates of sustainable agriculture decree that their way is good for farming. It will change when the price of fertilizer gets too high. Similarly, the solution to soil erosion and other resource problems lies not in righteous statements about the evils of modern farming (or of modern industry, science, and society), but in the hard work of devising public policies that create the incentives to overcome economic obstacles. Designing such policies to be politically acceptable is perhaps even harder. It is a pity that those who have a keen understanding of the

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The SDI controversy reminds us that very prominent scientists can be very wrong, especially in the heat of political debate.

need to move toward sustainable use of natural resources are not willing to make the effort where it matters. □

STEPHEN BUDIAISKY, a congressional fellow, was formerly Washington editor of *Nature*.

Experts Fight over SDI

How to Make Nuclear Weapons Obsolete
by Robert Jastrow
Little, Brown, \$15.95

Reviewed by Carolyn Meinel

In *How to Make Nuclear Weapons Obsolete*, Dartmouth physics professor Robert Jastrow provides an entertaining but solid outline of the goals and technologies of President Reagan's effort to develop a ballistic-missile defense. Jastrow also shows how opponents of the Strategic Defense Initiative (SDI) have misled the press and public by drastically exaggerating the number of orbiting battle stations that would be required for such a defense. Although Jastrow names no names and retains the collegial style of his earlier popular-astronomy books, one can detect a note of glee as he highlights the mistakes of SDI opponents. Although these critics have now admitted many of their errors, the exaggerations have colored the whole SDI debate and made it difficult for ordinary citizens to weigh the merits of the Star Wars program.

For example, the Union of Concerned Scientists (UCS), one of the groups leading the fight against SDI, originally estimated that 2,400 satellites would be required for a ballistic-missile defense. Nobel laureate Hans Bethe, M.I.T. professors Henry Kendall and Victor Weisskopf, and Cornell astronomer Carl Sagan were among the prestigious authors of the 1984 report containing this estimate, entitled *Space-Based Missile Defense*. In congressional testimony, a representative of the UCS lowered the organization's estimate to 800; the group later reduced the figure further to 300 and then to 162.

Richard Garwin, a fellow at IBM's Watson Research Center and also a prominent author of the UCS report, has recently decided that only 79 battle stations would be required. This figure that is close to the estimates put forward by Jastrow and other SDI proponents. Garwin had origi-



nally made a similar calculation in a 1981 *Bulletin of Atomic Scientists* article, but after Reagan's Star Wars speech he raised his estimate by 30 times to agree with the UCS report.

The UCS also changed its original claim that a 40,000-ton satellite would be required to field a particle-beam weapon, admitting that a 25-ton satellite would be able to do the job. These exaggerations have been repeated in book and scientific articles and trumpeted in press conferences to prove that ballistic-missile defense is prohibitively expensive. The figures have also been used to cast doubt on the competence of SDI researchers and the feasibility of the whole venture.

But at least we can see a happy ending to the SDI debate, right? Free and open discussion among defense researchers will eventually bring all the facts to light. The press can then sort out the best information and inform the public, which with our nation's leaders will be able to decide on the shape of our national defense.

The problem is that ballistic-missile defense has been a political issue since the 1950s, and the two sides are battling each other from entrenched positions. On one side we have the theoreticians who belong to the mutual assured destruction (MAD) club, which held power during the two decades since the days of Kennedy Defense Secretary Robert MacNamara. These analysts believe that efforts to develop a ballistic-missile defense are futile, and indeed that they are likely to touch off a nuclear

war. The other camp is composed of a smaller number of iconoclasts who gained power only recently with the support of President Reagan. When the MAD enthusiasts complain that Reagan launched SDI without consulting the defense establishment, they are referring to themselves.

You would think that since the president is the one who created SDI, today's outsiders—the MAD crowd—would feel pressure to defend their position. However, these people were yesterday's insiders and still hold powerful positions in industry, academia, the national laboratories, the Pentagon, and the State Department. Instead of buttressing their own arguments, members of this group have sometimes tried to use their influence to stifle debate over the strategic defense that they so strongly oppose.

Consider Los Alamos physicist Gregory Canavan, the most persistent critic of the inflated satellite numbers being circulated by the UCS. Until mid-summer of 1985, he had debated Richard Garwin at the annual meeting of the American Institute of Aeronautics and Astronautics and in private forums. Then Canavan's associates began to complain that he had been muzzled—banned by Los Alamos management from speaking to the press and engaging in public debate. These associates say that Canavan is no longer allowed to circulate even technical memos without prior screening, and in fact Canavan has canceled all his speaking engagements. Colleagues maintain that he was yanked from public view in response to complaints by Garwin, who allegedly accused Canavan of slander. (It is normally a privilege and not a right for people who hold security clearances to speak and write publicly on defense topics.)

Garwin may also have attempted to silence Lowell Wood, a manager at Lawrence Livermore Laboratory in California and like Garwin a member of the elite Jason Group of defense analysts, which is sponsored by various government defense agencies. Garwin charged that Wood slandered him in telling Congress that their Jason colleagues had never supported Garwin's analyses of alleged flaws in the x-ray laser. Garwin also charged Wood with using laboratory funds to express his private views on SDI in congressional testimony. Wood contends that it is standard practice for the lab to fund researchers in responding to congressional requests. According to one source, when the director

of the lab refused to act on Garwin's complaint and silence Wood, Garwin took his case to senior officials at the University of California, which oversees the lab. Even though Wood escaped censure, he spent much time and energy responding to Garwin's charges.

The SDI controversy reminds us that very prominent scientists can be very wrong, and that they can go to extreme lengths to discredit their opponents—especially in the heat of political debate. When issues of scientific fact become entangled with politics, it is difficult for people to decide which experts have the right story on which issues. Thus, there is probably no one who could write a book that would reveal the true dimensions of our choices for nuclear defense. Jastrow's book only scratches the surface of the debate. But it scratches deep enough to inspire a healthy skepticism for the pronouncements of defense experts. □

CAROLYN MEINEL is a defense expert working on the Strategic Defense Initiative for Analytic Decisions, Inc., which is based in Arlington, Va.

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How to Put Large Structures in Space? Build Them!

How much real work can people do in extravehicular activity (EVA) in space?

On the answer depends our ability to build large structures, such as a space station, that will be brought into space piece by piece for erection in orbit.

NASA's first EVA experience was discouraging. But two decades later the outlook for construction of major facilities in space is far better. M.I.T. research that culminated with EVA experiments on *Atlantis*, shuttle flight 61-B, suggests that assembling structures in space may be easier than in any earthbound simulation yet devised.

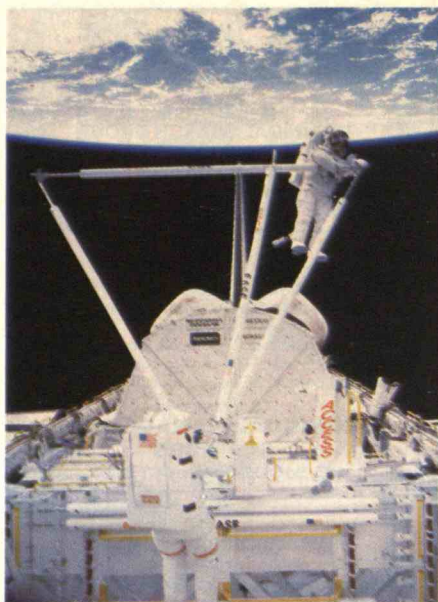
After the Gemini project in 1965 and 1966, NASA's conclusion, as reported in the official project history, was that "all chores took longer than foreseen, and body positioning was difficult. . . . Extravehicular activity remained Gemini's greatest problem."

Even after the Skylab program in 1974, the general view was that people would not be very productive at assembly tasks in space, in terms of weight of structure assembled per person per hour. Almost any task could be done, but it would take longer and be harder than in a gravity environment. The pressure-suit gloves made handling hardware and tools difficult, and having constantly to control their body position was time-consuming and tiring for the astronauts.

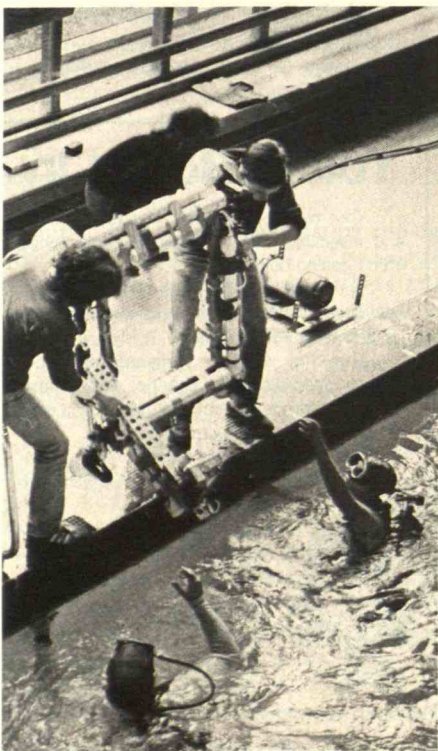
Sensing that if large structures were to be deployed in space they would have to be assembled by astronauts in EVA, the M.I.T. Space Systems Laboratory (SSL) began studies of beams and fasteners for simple structures in 1977. First tests were made by students working in the M.I.T. swimming pool, where the buoyancy of water simulated the weightless environment of space. The first conclusions were encouraging: given properly designed equipment and plenty of practice, the aeronautics and astronautics students found they could be more productive underwater than on the ground.

A year later NASA funded SSL to repeat these tests in the near-zero-gravity environment of a 40-foot-deep water tank called the Neutral Buoyancy Simulator at the Marshall Space Flight Center. SSL students wearing Skylab pressure suits adapted for underwater use repeated the tests and confirmed the conclusions they had come to at M.I.T.

Then came NASA's contract with SSL



Studies of how humans could assemble structures in gravityless space began a decade ago in the neutral-buoyancy environment of the M.I.T. swimming pool (below). After tests on shuttle *Atlantis* (above), Professor David L. Akin is enthusiastic: "Anything you can do underwater you can do in space."



for the next stage of the work—a study of experimental assembly of structures in extravehicular activity (EASE). The study was expected to culminate with tests on a space-shuttle flight.

As designed by SSL, the basic EASE apparatus consisted of six 12-foot aluminum beams, each weighing 62.5 pounds. There were detachable joints so that the beams could be assembled into a tetrahedron, and there were also a base to hold the structure to a shuttle's payload bay, a foot restraint for one of the astronauts, and detachable tethers to prevent the beams from escaping in their weightless condition. Also prepared for flight on the shuttle was a photographic film listing the 55 M.I.T. faculty, staff, and students who had helped over nearly a decade to design and build EASE.

EASE was first tested in the M.I.T. pool and in the Neutral Buoyancy Simulator. Then came the flight on *Atlantis* last November: How would the assembly of EASE in EVA compare with its assembly in underwater simulation?

To find the answer, astronauts Jerry Ross and Sherwood (Woody) Spring assembled and disassembled the EASE beams eight times in EVA on the fourth day of flight 61-B, and they repeated the exercise, with minor variations, on the sixth day of the mission.

Analysis of the movies made of their work is continuing. But it is already clear that the results were good: the astronauts initially performed the EASE tasks more quickly in space than in the simulation tank, and as they practiced in space, they learned to perform the tasks more quickly still.

The astronauts found the EASE assignment gave some unexpected problems in space. Said Spring, "In space I found myself grabbing a couple of times with my legs just to give myself some stability. Otherwise, you'd tend to roll around on those poles almost like a log in the water." Added Ross, "I think . . . probably the main reason Woody, and to some extent myself, tried to do that is because we did not have the viscosity of the water helping us when we were trying to maintain body position."

Jubilant, Professor David L. Akin of SSL concludes that "anything you do underwater you can do in space." The space station, he predicts, will be built piece by piece by astronauts in EVA—just the way EASE proved it could be done. □

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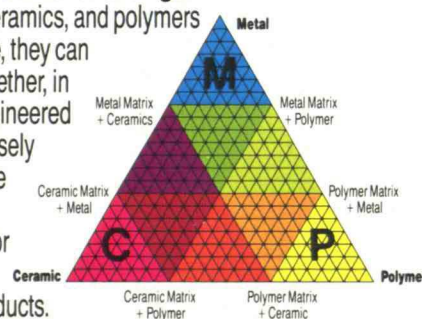
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